NEW ZEALAND GOAT INDUSTRY

The Agricultural Research Division Perspective

Cover photograph: A doe and her eight 'offspring'

The doe was treated with a hormone to produce a large number of eggs. The fertilised eggs were collected and implanted in recipient does. This technique can be used to rapidly increase genetic gain by using superior sires and does.

The photograph shows all this doe's offspring collected together.

THE NEW ZEALAND GOAT INDUSTRY
THE AGRICULTURAL RESEARCH DIVISION PERSPECTIVE

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MINISTRY OF AGRICULTURE AND FISHERIES
WELLINGTON, SEPTEMBER 1985

MAF Libraries cataloguing-in-publication data.

Kettle, P R

The New Zealand goat industry : the Agricultural Research Division perspective / P R Kettle and D E Wright.

1v.

1. Goat breeding--New Zealand 2. Goat industry--

New Zealand I. New Zealand. Agricultural Research Division II. Wright, D E III. Title

ISBN 0477030440

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SUMMARY

1. This report reviews the New Zealand goat industry and opportunities for increasing income from goat products. It identifies and describes these products, their end uses, value and opportunities for increasing value and volume.

2. The report considers goat nutrition, behaviour, diseases, reproduction, breeding, weed control, and production of fibres, meat, skin and milk.

3. The major obstacles facing the industry are identified with emphasis on those aspects where technical data is not available.

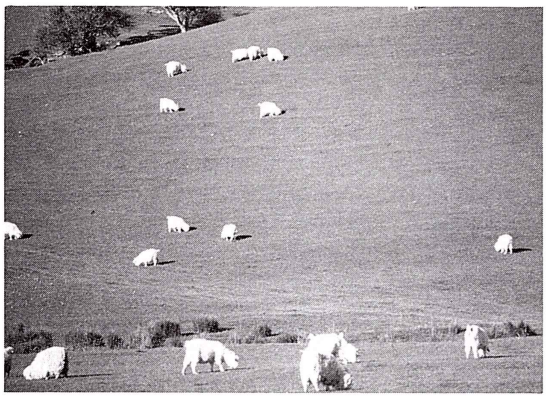
4. Current research on goats in the Agricultural Research Division (ARD), MAF is described including a description of individual research projects.

We gratefully acknowledge the assistance of the following who commented on the paper when in draft form:

G J Batten
G Cumberland
A H Kirton
K D McSporran
R V Brunsdon
J E Radcliffe
M L Bigham
C J Horton
M Horgan

Photographs supplied by Ruakura Agricultural Research Centre, Invermay Agricultural Research Centre and Rick Hakkart of Meadows Media.

INTRODUCTION



Goat farming is a rapidly expanding industry in New Zealand with few resources, limited expertise and comparatively small production. Its long term future will depend upon profitability, not from the local sale of animals at high prices, but from the sale of its main products; milk, fibre, skins and meat.

While many goat farmers at present regard their involvement as a hobby rather than a profitable venture, others are entrepreneurs who see substantial profit opportunities. Eventually, animal value will represent the value of specific products or the value of the goats' role in farm management.

Goats were probably amongst the first ruminants to be domesticated. The Persian wild goat, or bezoar *Capra hicus aegagrus* was the species concerned (Mason, 1981). The earliest bones identified as belonging to domestic goats were found in Khuzestan, south-west Iran. They date from before 7000 BC and were located away from the mountain habitat of the bezoar. Identification of the remains as being domesticated animals was based on the high proportion of bones from yearlings (Mason, 1981). The climate in the region is harsh with extremes in temperature but little rainfall.

Goats are particularly well adapted to hot and dry conditions but may thrive under almost all climatic conditions. However, goats in general dislike rain. If feeding is reduced during extended spells of rain and cool weather, they may be affected because rumen fermentation decreases and they may have difficulties in maintaining their body temperature (Gall, 1981).

There appear to have been three main reasons for the introduction of goats in to New Zealand. Firstly, they were liberated to provide emergency food both on the mainland and outlying islands, secondly, Acclimatisation Societies released Angora goats in the hope that their skins would be of commercial value, and thirdly, goats were spread in an effort to check the spread of blackberry (Thomson, 1922; Wodzicki, 1950).

It is popularly believed that all the wild goats of New Zealand are descended from those introduced by Captain Cook but, while this may be partly true, it is more likely that they are descended from escaped animals (Thomson, 1922). The origins of feral populations on outlying islands appear more clear cut (see Rudge, 1976).

Data on the distribution, and density, of feral goat populations are currently being collated from information supplied by the New Zealand Forest Service (M R Rudge, pers comm).

Batten (1984a) examined the commercial traits of Arapawa Island goats and found that they appear to possess no particularly beneficial characteristics other than well formed feet. Other populations, however, may possess more valuable genes and the call by Rudge *et al,* (1985) for work on the distribution and productivity of feral goats deserves support.

During the last thirty years the number of goats in the world has increased steadily. The FAO (FAO, 1971) estimated that the total goat population in the period 1947/48—1951/52 was 291 million and that it had increased to 476 million by 1983 (FAO, 1984). Currently world sheep numbers are approximately 1137 million (FAO, 1984) but goat numbers, increasing at a rate of one percent annually, are rising twice as quickly.

Periodically goat farming has been proposed as either an alternative or an adjunct to traditional pastoral farming in New Zealand. Advocates for goat farming, who were considered until quite recently to be a little eccentric at the least, can now draw comfort from the fact that the status of goats has changed from 'noxious' to almost 'noble' within a few years.

It is estimated that at present in New Zealand there are about 400,000 feral goats and there were over 230,000 goats on farms at the June 1984 census (Department of Statistics).

It appears likely that for some time to come top priorities for goat research within the NZFS and DSIR Ecology Division will involve projects which are either directly or indirectly aimed at eliminating feral goats from Crown Land. In contrast MAF may well be involved in efforts to build up the goat resource because of the commercial potential now recognised in goats. Conflicts of interest appear inevitable so efforts to minimise these must be made. Channels of communication have, however, already been established between parties through the Wildlife Research Liaison Group (WRLG).

NUTRITION

Wilkinson and Stark (1982) produced the following summary:

Goats appear capable of a greater level of voluntary feed intake than do sheep relative to their metabolic body weight (Owen, 1980; Gihad, 1981). Thus when given diets of medium quality hay the intake of hay was greater for goats (78 g DM/kg $W^{0.75}$ day) than for sheep (59 g DM/kg $W^{0.75}$ day). Surprisingly, the higher intake by the goats was not reflected in a depression in the digestibility of the organic matter (OM) compared to sheep (54 percent and 55 percent respectively for the goats and sheep) (Owen, 1980).

Although the digestibility of the total dry matter (DM) of diets does not appear to be consistently superior in goats than in sheep or cattle, most studies indicate that the crude fibre fraction is digested more efficiently by goats than by other ruminants (Devendra, 1978; Gihad *et al,* 1980; Owen, 1980; Cuddeford and de Waard, 1981; de Simiane, Giger, Bianchart and Huguet, 1981; Devendra, 1981). For example, Gihad (1976) recorded that the crude fibre digestibility of hay was 56.5 percent for sheep and 60.3 percent for goats. Wilson (1977) found that the digestibility of the acid detergent fibre fraction of tree leaves was 14.2 percent for sheep and 20.7 percent for goats, while Gihad *et al,* (1980) recorded a difference of 10 percentage units in crude fibre digestibility between sheep and goats given rice straw (53.1 percent and 63.3 percent respectively). Throckmorton (1981) suggested that the difference between sheep and goats in cell wall digestion may be related to an increase in retention time in the rumen, to increased salivary secretion during resting and feeding, and possibly to a greater proportion of time spent ruminating by goats compared to sheep. Other factors which may contribute to increased efficiency of digestion in goats are higher numbers of cellulolytic bacteria in the rumen, a higher quantity of urea recycled to the rumen and a larger relative rumen volume (Gihad *et al,* 1980: Gihad, 1981: Morand-Fehr, 1981a: Shkolnik and Silanikove, 1981).

The few data available on the maintenance energy requirements of goats indicate values on a metabolic body weight basis similar to those for sheep and cattle (Oldham and Mowlem, 1981; Sauvant, 1981), although Mohammed and Owen (1980, 1981) found that the maintenance requirements of goats were significantly higher than those of sheep.

In calculating feed requirements it appears that a goat equivalent (ge) equal to about 0.7 of a stock unit (su) is appropriate for 'feral' type animals (see Batten, 1984c; based on 40 kg liveweight). However, this unit will vary according to the type of feed being utilised as well as the breed of goat. For example, on hill country goats of 25-30 kg liveweight run in conjunction with sheep and cattle equate with about 0.3 su (Kirton *et al,* 1985). On dairy goat farms a ration equating five goats to one cow has been suggested (Jagusch *et al,* 1981) while Kirton *et al,* (1985) suggest an average Saanen doe is equivalent to about 1.5 su where management systems include goats with cattle.

The maintenance requirement of a 50 kg Saanen doe is about 500 JK ME/kg $^{0.75}$, equivalent to a dry matter intake of 0.9 kg/head/day of pasture (Jagusch and Kidd, 1982). During peak milk flows the doe requires 300-350 KJ ME/kg $^{0.75}$ for each litre of milk produced (0.5 kg dry matter of pasture). During the dry period a doe eats 1.2-1.4 kg dry matter in preparation for lactation (Jagusch and Kidd, 1982). Huston *et al,* (1971) discussed the nutritional requirements of the Angora goat and Louca *et al,* (1982) the comparative digestibility of feedstuffs by various ruminants.

While goats will produce on weeds and brush (Little, 1974; Leighton, 1978) they are unlikely to milk well on them and there appears to be no economic substitute for improved pasture for milk production in New Zealand (Horton, 1982a). Angoras, too, have a high nutritive requirement (Shelton, 1981).

Horton (1984) found that within a wide range of supplement rates that prenatal nutritional treatments were without effect on kid birth weight but concluded that post-natal nutrition of the doe is important if high milk yield is to be obtained.

Guidelines on feeding goats for milk production are given by Horton and Jagusch (1984).

Requirements for Kids

Several experiments have compared the efficiency of feeding different types of milk. When fed at the same concentration, goat milk, cow milk, or milk replacer have resulted in similar growth rates (Morand-Fehr, 1981b). However, kids are less efficient than either calves or lambs when fed milk diets (Jagusch *et al,* 1983). Weaned kids appear to require about one kg of dry matter intake per day (Jagusch and Kidd, 1982).

Carcass weights of kids are directly related to their nutrition in early life and especially to their dam's milk production (Batten and Alington, 1985).

Horton (1982b) reviewed the various methods of rearing dairy kids and discussed target weights. Information on target weights for feral/Cashmere and Angora goats under New Zealand conditions is lacking.

BEHAVIOUR

Goats are gregarious in the sense that they prefer to stay close together and are rarely seen apart from the group. They will follow a leader making a dash for freedom when the flock is being driven (Ross and Berg, 1956).

Within goat societies there is a clear dominance structure. With does, the correlation of leadership with age or dominance is very low (Kilgour and Ross, 1980). However, with feral goats, the dominant male in a group (called the alpha male) carries out most of the mating. With males, social dominance appears to correlate with body weight and horn length (Kilgour and Dalton, 1984).

Angora buck showing sensing behaviour.

Goats adopt a variety of agonistic behaviours. Perhaps the most intense interaction is the exaggerated butt, where the protagonists rear with their front legs high in the air and then lunge at each other. Other equally effective aggressive postures during feeding include sideways hooking with the horns, butting the flank of another feeding goat, and ear biting (Syme and Syme, 1979).

The development of dominance appears to be preceded by bouts of play fighting and is usually well established by six months (Collins, 1956). They do not combine to attack a more dominant goat (Ross and Berg, 1956).

Two physical characteristics have been found to influence social rank in goats. Body weight is perhaps the key attribute but the possession of horns is also important for establishing the outcome of aggressive encounters.

Pretorius (1970) observed dominance in flocks of goats of varying body weight and found that the submissive lighter animals lost the most body weight under conditions of partially restricted feeding. However, deficit was rapidly recovered when the goats were regrouped into flocks of similar weight.

The dominance order exerts little, if any, control over the level of aggression within Saanens (Syme *et al,* 1974).

Social dominance amongst kids can be altered by de-horning and this should be carried out before two weeks of age where possible (Kilgour and Dalton, 1984).

Two studies report a direct relationship between social rank and mohair production (Marincowitz, 1968; Pretorius, 1970). For one of the groups in the second study the correlation between these two variables was 0.97.

Differences in behaviour between breeds have been reported although the field has received little attention. Mill *et al,* (1982) compared the behaviour of Alpine and Boer bucks. They found marked differences in several behavioural activities but perhaps most significant was the finding that mixed groups were more restless than single-breed groups, even though all animals had been reared together.

A characteristic of goats is that kids are left 'hiding' or 'lying out' for periods of up to about eight hours while the doe wanders off feeding. The doe will then return to the 'lying out' position. This behaviour pattern lasts for up to several weeks. In keeping with this pattern, kids on their dam's feed infrequently compared to lambs. The dam-offspring bond appears to be the strongest social tie which develops within goats (Kilgour and Dalton, 1984).

Kid survival is dependent on a good bond between doe and kid so it is important that no interruptions disturb them immediately after birth. Evidence from the USA indicates that does and kids should either be given intensive care or that the herd should be left entirely alone (easy care). Intermediate type husbandry is likely to prove disruptive (Kilgour and Dalton, 1984).

Free-ranging goats show a marked preference for hilly terrain or areas with a dense tree or shrub cover (Harrington, 1982). They display a tendency to develop night-camps which they use regularly. These camp-sites are often stripped and when on steep hills can be centres of erosion (Harrington, 1982).

The grazing behaviour of goats may play an interactive role with disease transmission and this aspect could require further study. For example, the set patterns of grazing, sheltering and resting adopted by herds of goats could result in very high numbers of infective nematode larvae being located in areas favoured by the goats. In addition where shelter is provided for goats such structures could provide focal points for the transmission of viral and bacterial diseases. Horton and Jagusch (1984) advocate the provision of ample supplies of roughage during inclement weather as an alternative to shelter.

DISEASES

Goats are susceptible to a wide range of diseases (comprehensively reviewed by Lloyd, 1982). Those due to micro-organisms are summarised in Table 1. Angora goats are particularly sensitive to exposure (Shelton, 1981) and goats generally are less hardy than sheep under adverse weather conditions.

Nematodes

Gastrointestinal nematodes are generally believed by goat farmers to be the major animal health problem threatening their herds. This is particularly true on dairy goat farms where they can severely limit production.

In New Zealand, as in the USA (Baker, 1975; Lloyd and Soulsby, 1978; Guss, 1977) and Australia (Le Jambre and Lumbers, 1981) the main genera of worms affecting goats are *Haemonchus*, *Trichostrongylus*, and *Ostertagia* (Kettle *et al,* 1983). Brunsdon (1982/83), however, in a study where sheep and goats ran together found that the principal genera, in order of numerical dominance were *Trichostrongylus* spp, *T.axei*, *Haemonchus contortus*, *Nematodirus* spp and *Cooperia curticii.* He reported that the relative generic composition of infections acquired by lambs, kids, and 2-tooth does did not differ significantly.

The apparent relative lack of a natural age-related resistance to infection, compared with that found in sheep, means that the farmer has to rely on management and the application of anthelmintics to combat nematodes throughout the lifetime of his goats (Kettle *et al,* 1983). Faecal egg output is upto four times greater in goats than in sheep with comparable worm burdens (Anon, 1982) and in Holland, at least, there appears to be no peri—or post-parturient rise in faecal egg output (Jansen 1982).

Controlling gastrointestinal nematodes in goats is becoming progressively more difficult as strains of worms resistant to various drenches emerge.

Taking faecal egg count depressions of 80% as being indicative of a 'resistance problem', Kettle *et al*, (1983) found resistance on 37 of 47 of dairy goat farms surveyed. On the dairy goat farms involved in the survey drenching frequency was high (average 12.5 times for kids during their first year and 13.4 for does over one year of age) so selection pressure favouring resistant worms was also high. Such a high selection pressure is unlikely to be imposed on extensively farmed goats and the threat of resistance will be proportionately lower.

The efficacy of drenches against nematodes in goats requires further investigation by the marketing companies. This is because it is now accepted that goats metabolize some drenches at a rate faster than that of sheep and that the common practice of lumping the two species when making dose recommendations is unacceptable. The Animal Remedies Board's course of action has been to ask for specific goat-based efficacy data. They may then deregister drenches where insufficient data on efficacy against worms in goats can be provided. However, as the market is very small this move could result in no action being taken by the companies and farmers continuing to use the products regardless of recommendations. Currently regulations are being ignored with regard to the drench Ivomec® . This drench is very effective against worms in goats and is being used widely although not registered for this use. Summaries of efficacy trials have been presented by Elliott (1982/83) and Vlassoff and Kettle (1983/84).

As sheep and goats share their nematode parasites it is generally unwise to combine the two species in a rotational grazing system where frequent drenching is required. However extensive operations involving sheep and fibre producing goats on hill country should be feasible and work is required in this area. Goats browsing on shrubs face low exposure to infective larvae and so long as their overall plane of nutrition is sufficiently high parasites should have little effect on them.

The long-term options for worm control in fibre producing goats are wide compared with those for dairy goats. For dairy goats all drenches have a designated milk withholding period and the shortest of these is 24 hours. Long-acting drugs such as closantel and disophenol may prove useful in fibre goats where residues are of minimal importance.

Within herds individual goats have been found to contribute a disproportionate number of worm eggs to the pasture. It appears appropriate that these animals should be identified at an early stage and culled but work on this area is required. Another option would be to treat these animals selectively. Anderson and May (1985) suggested (on theoretical grounds) that when certain individuals or groups are predisposed to heavy infection treatment of them alone can have a significantly greater impact on the level of herd immunity than blanket treatment. The benefit of selective treatment being that it does not reduce the level of immunity in the herd to such an extent as that following blanket treatment.

Preston and Allonby (1978), in Kenya, found that the nutritional status of the host influences its resistance to *H. contortus* infection. They also found differences between goat breeds in their susceptibility to *Haemonchus*. Saanens proved to be less susceptible than East African and Galla goats in their trial.

Besides gastrointestinal nematodes, goats are also parasitised by lungworms—*Dictyocaulus* spp and *Muellerius capillaris*. *Muellerius*, in particular, can cause verminous pneumonia in goats (Lloyd and Soulsby, 1978).

Cestodes

Goats act as intermediate hosts for *Echinococcus granulosus*, *Taenia hydatigena* and *T.ovis*. The larval stage of *T.ovis* is rare in goats but the cysts appear to persist longer than in sheep (Anon, 1973 cited by Williams, 1981). The goat is a definitive host for *Moniezia expansa* but this parasite has no proven pathological effects on its hosts (Elliott, 1983).

Trematodes

Liver fluke, *Fasciola hepatica*, parasitize goats but do not appear to pose a significant threat to their health under most management systems operating in New Zealand. However, goats are apparently more susceptible to fascioliasis than are sheep and in some parts of the Waikato, where goats are intensively grazed on swampy land, problems are evident (Ross Jackson, pers comm).

Table 1—Diseases due to Micro-organisms

BACTERIAL DISEASES		REFERENCE
Bacterioides (Fusiformis) nodosus	Foot Rot	Skerman & Christiansen(1978)
Clostridium perfringens	Enterotoxaemia	Ellison (1985)
C. tetani	Tetanus	Hulme-Moir (1982)
Corynebacterium ovis	Caseous lymphadenitis	Ellison (1985) Gus (1977)
Escherichia coli	Mastitis	Ellison (1985)
Leptospira hardjo L. copenhageniL. pomona	Leptospirosis	Ellison (1985)
Listeria monocytogenes	Abortion, Nervous disease	Hulme-Moir (1982) Ellison (1985)
Mycobacterium paratuberculosis	Johne's disease	Ellison (1985)
M. bovis, M. avium	Tuberculosis	Ellison (1985)
Pasteurella haemolytica, P. multocida	Pneumonia	Ellison (1985)
Salmonella spp	Scours	Sutherland (1982a)
Staphylococcus aureus	Mastitis	Ellison (1985)
Streptococcus spp	Mastitis	Ellison (1985)
Dermatiphilus congolensis	Dermatitis	Ellison (1985)
Yersinia pseudotuberculosis	Yersiniosis	Ellison (1985)
FUNGAL DISEASE		
Trichophyton	Ringworm	Guss (1977)
VIRAL DISEASES		
CAE virus (a retrovirus)	Caprine arthritisencephalitis*	MacKenzie & Oliver (1984)
Contagious ecthyma virus	Scabby mouth	Ellison (1985)
Herpes virus	Herpes vulvovaginitis	Ellison (1985)
Corona virus	Scours	Sutherland (1982a)
Rota virus	Scours	(K D McSporran, pers comm)
PROTOZOAL DISEASES		
Eimeria spp	Coccidiosis	Hulme-Moir(1982)
Giardia caprae	Giardiasis	Sutherland(1982b)
Sarcocystis spp	Sarcocystis	Collins & Crawford (1978)
Toxoplasma gondi	Toxoplasmosis, abortion	Ellison (1985)

**Animal Health Division of MAF have set up a voluntary scheme to accredit goat flocks free of caprine arthritis encephalitis (CAE). The workings of the scheme have been described (Anon, 1984; Anon, 1985).*

Ectoparasites

In New Zealand, goats are exposed to a wide range of ectoparasites but under normal management their effects are slight and have little effect on production. Lice *Damalinia caprae*, *D. limbata* and *Linognathus stenopsis* are the ectoparasites which most commonly attract attention. Treatment against lice involves shower dipping with an insecticide such as diazinon in a sheep dip formulation. When applied properly, it should afford about 6 weeks' protection from reinfestation and this should be long enough to break the life cycle (Clear *et al*, 1982). Dairy goat farmers frequently use 'pour-on' formulations for lice control in their herds. While this method should give adequate control, it is unlikely to result in eradication.

Ectoparasites of goats in New Zealand were reviewed by Kettle (1982).

Footrot and Footscald

Goats are susceptible to footrot, and as, by analogy with sheep, predisposition to the condition may be heritable, it could be worth culling sufferers. This point would be worth consideration in the planning stage of any breeding programme. Control methods, other than vaccination, used against footrot in sheep (Skerman *et al*, 1984) are appropriate for goats. Goats are inclined to develop a localised reaction at the site of injection (T M Skerman, pers comm). Furthermore, currently available vaccines are not registered for use in them.

Undefined Microbial Conditions

Pneumonia of unknown aetiology is an emerging problem associated with transportation of goats with losses of up to 10 percent being reported in some instances (H Davies, pers comm). Pink eye in goats also appears to be on the increase and is typically more severe than in sheep.

Facial Eczema

In general goats appear to be much less susceptible to this disease than are sheep but work in this area, aimed initially at evaluating the problem, is under consideration (B L Smith, pers comm).

Nutritional deficiency diseases

The nutritional diseases affecting goats closely parallel those of sheep and supplementation in specific element deficient areas is essential. Deficiencies of four trace elements, cobalt, iodine, selenium, and copper, are of major importance in New Zealand (Millar, 1978).

Kid losses due to induced iodine deficiency have been recorded at Adair, Timaru (C C McLeod, pers comm). Thyroids weighing upto 43g, compared with the normal of approximately 2.5g, were recovered from the affected kids. Goitrogenic soft turnips were held responsible for the deaths.

Metabolic diseases

Milk fever, ketosis and bloat all affect goats to some extent (Brookbanks *et al*, 1981).

Normal physiological values are given in Table 2.

Current Research Projects

RA803 Milk quality and yield responses to successful parasite control in milking Saanen goats

Proposer: T G Watson;
Location: Ruakura
Period: Started 1984 finish 1985

Objectives:

The objectives are to examine gastrointestinal nematode parasitism in Saanen milking goats in relation to seasonal parasite challenge on pasture, anthelmintic treatment efficacy and milking performance.

Approach:

Forty-five mixed age Saanen does were randomised into three treatment groups on the basis of age, kidding date and cull record. All animals are drenched at 21 day intervals, each group receiving a different anthelmintic (ivermectin, morantel, oxfendazole) treatment.

Parasitism and drench efficacies are being monitored by faecal egg counts, cultures and nematode larval challenge on pasture estimation. Milking peformance is being evaluated on the basis of daily yield and milk assay (weekly). Animal health is being evaluated by monitoring packed cell volume, haemoglobin, serum protein and albumin.

Table 2—Physiological Data and Clinical Chemistry of Goats

Bloodvolume	90ml/kg
Erythrocytes	11-15 x10^6/mm^3
Diameter	3.2 µm
Packed cellvolume	28-35%
Leukocytes	8000-11000 x 10^3/mm^3
Lymphocytes	50-70%
Neutrophils	30-50%
Eosinophils	1-10%
Monocytes	0-6%
Basophils	<1%
Plasmaproteins	60-78.5 g/l
Albumin	27-39g/l
Globulin	23-46g/l
Temperature	39.4°C (38.6-40.6°C)
Heartrate	70-90beats/min
Respiratoryrate	15-30/min. Polypnea may be seen.
Urine: Specificgravity	1.015-1.050
pH	7.0-8.0
Volume	10-40 ml/kg bodyweight/day
Milk: Fat	3.5% or more
Protein	3.1%-3.5%
Casein	2.7%
Whey	0.8%
Lactose	4.6%
Ash	0.8%
Semen: Volume	0.5-2.5 ml
Sperm concentration	1000-5000 x 10^6/ml
Blood values	
Glucose	2.2-3.3 mmol/l
Calcium	2.4-2.6 mmol/l
Magnesium	1.0-1.4 mmol/l
Potassium	3.5-6.3 mmol/l
Chloride	100-120 mmol/l
Phosphate, inorganic	1.2-2.5 mmol/l
Urea	4.0-9.9mmol/l
Creatinine	80-159 mol/l
Total Bilirubin	<17 µmol/l*
Aspartate aminotransferase	32.3 i.u./l
Alkaline phosphatase (ALP)	56.9i.u./l
Lactate dehydrogenase (LDH)	289.9 i.u./l
SGOT	50—100 SF units
SGPT	12.17 SF units
Ketones	10 mg/100ml
Totallipids	298.6 mg/100ml
Uricacid	1.0 mg/100ml
Puberty	4—12 mos.
Oestrum (length of heat)	12—36 hrs. (Avg. about 18 hrs)
Oestrus cycle	18—23 days
Gestation	148—153 days (avg 150)

Reporting: Annual Reports

Highlights:

Comparison of treatment of farmlet flocks of does with Ivomec*®, Synanthic®, or Exhelm-E® has shown a production advantage in favour of Ivomec® after 25 weeks of better than 0.6 l/day/animal. Furthermore significant differences in various blood parameters (haemoglobin, albumin and packed cell volume) have also developed with time suggesting improvements in condition.

Drench efficacies were low for both Exhelm-E® and Synanthic® (67-82% and 14-84%, respectively) but it was more irregular with the latter. Ivomec® was consistently more effective based on FECD but again occasional incidences of low FECD were observed.

*Ivomec® is not registered for use in goats, Synanthic® has a five day milk withholding period and Exhelm-E® a 24 hour milk withholding period.

RA772 Drench efficacy of Nilverm® and Ivomec® for gastrointestinal andlungworm infections in goats.

Proposer: T G Watson
Location: Ruakura
Period: Started 1984 finish 1985

Objectives:

1 To examine the efficacy of drenching at 21-day intervals with Nilverm® (oral) or Ivomec® (injectable) in controlling gastro-intestinal parasite and lungworm infections in goats.

2 To study serum proteins and packed cell volume (PCV) charges under the existing drench/challenge regimes with set stocked animals.

Approach:

Thirty-four goats were assigned into two mobs. Group A was given Nilverm® at 7.5 mg/kg and Group B injected with Ivomec® at 200 micrograms/kg at 21-day intervals. Animals were run together, set stocked. They were faecal sampled, weighed and scored for scouring at each drenching.

Blood samples were taken to examine serum protein and PCV changes associated with the pathophysiology of unsuccessful or reduced parasite treatment and control. Faecal samples were used for recovery, differentation and counting of parasite eggs and larvae.

Reporting: Annual reports.

WA155 Field trial studying the build up of anthelmintic resistance in a goat herd

Proposer: A Vlassoff
Location: Wallaceville
Period: Started 1982 finish—indefinite

Objective:

This trial is being conducted to test the hypothesis that frequent under-dosing is the strategy most likely to lead to a rapid build up of a 'resistance problem'. That is the situation where the number of worms being picked up by the grazing animals is sufficient to cause clinical disease despite routine drenching.

Two mobs of Saanen goats are grazing matched pastures which were seeded evenly with anthelmintic resistant worms from a contaminating herd at the start of the trial. One mob of goats is being drenched with oxfendazole at a rate of 5 mg/kg (the manufacturer's recommended dose but considered to be an under dose for goats) and the other at 10 mg/kg. Drenches are being given every four weeks. Faecal egg counts, body weights and pasture larval levels are being monitored.

Reporting: Annual Reports.

PM31 The efficacy of various anthelmintics in Angora and feral goats.

Proposer: A Litherland, W Stiefel
Location: Flock House
Period: Started March 1985 finish June 1985

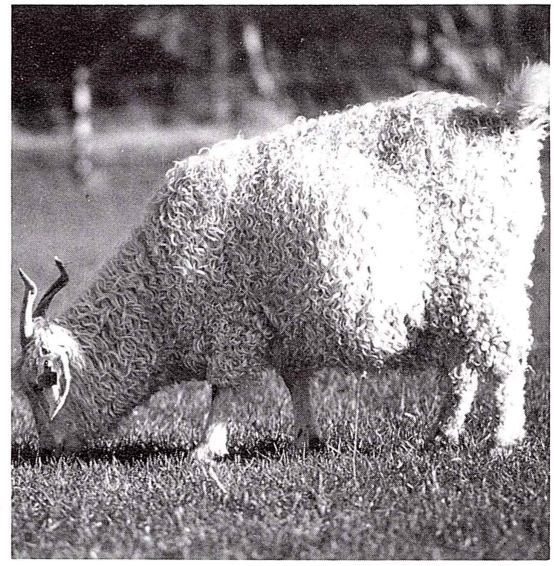
Objectives:

The control of gastronintestinal nematodes presents a major problem for the New Zealand goat industry. The inappropriate use of drench types and dose rates may lead to a widespread drench resistance problem which could be transferred to sheep. The objective of this trial is to determine the efficacy of the following drench ingredients:

morantel citrate
levamisole
fenbendazole
oxfendazole
ivermectin.

Faecal egg count depression seven days after drenching will be used to assess the efficacy of the drenches. Recommended sheep dose rate and double the recommended dose rates will be used. The two breeds of goat in the trial will be Angora and ferals. It is hoped the trial will be carried out twice in the 1985 autumn.

REPRODUCTION AND BREEDING



A heavily in kid Angora doe.

Goats can generally be classified as seasonally polyoestrus with recurring oestral cycles commencing in autumn. The goat is a short day breeder with breeding activity being stimulated primarily by an increasing ratio of the number of hours of dark to light. The buck also exhibits

seasonal variation in breeding activity with variations in libido and semen quantity, quality and concentration (Howe, 1980).

In New Zealand feral goats' seasonality is not very marked and Rudge (1969) found only slightly increased sexual activity in summer.

The oestrus cycle is 18-23 days and heat lasts 12-36 hours. Puberty is reached at 4-12 months and gestation is 148-153 days (Guss, 1977).

Goats born early in the farming year will ovulate and conceive by eight months of age if adequately nourished. They are generally more prolific than either the sheep or the cow with two kids usually being born and three being common (Robertson, 1977). Farmed 'ferals', though, kid more poorly and kidding percentages below 100 appear to be normal (Crouchley, 1983).

Farmed 'feral' or fibre producing does should be at least 18 months old or 2/3 of anticipated adult live-weight before mating. Delaying mating until the two-tooth stage is important as kidding limits females' growth under extensive grazing conditions (Batten, 1984).

Bucks may be used lightly during their first breeding season and for normal service (50+ does per season) thereafter (Shelton, 1978). However, Angora bucks may not show sexual activity until their second year (Shelton, 1978).

The weight of the doe at tupping and the plane of nutrition have a bearing on fecundity. Generally when goats are on a high plane of nutrition their fecundity increases (Sachdeva *et al,* 1973). Furthermore, the importance of nutrition for fertility is reflected in relationships between body weight and kidding percentage, as reported in Angora does by Shelton (1981). Reid and Horton (1982) calculated the value of this relationship in Saanen does to be a 3.4 percent increase in kidding with each kilogram increase in liveweight at mating.

The interval between kiddings is of great importance for the economics of production. Does can kid twice within a year (Rudge, 1969) but more usually kid once. Research into twice yearly kidding is planned at Whatawhata.

Malnutrition may effect fertility rates through abortions which often remain unobserved (van Rensburg, 1971).

The reproductive organs of does at all stages of pregnancy very closely resemble, except for size, the anatomy and function of the reproductive tracts of cows (Guss, 1977). Oestrus is not retarded during lactation. Nevertheless it is difficult to get does into kid in the first six months of lactation (G J Batten, pers comm).

With Angora goats, milk production tends to be antagonistic or negatively related to fibre production (Shelton, 1981). Also, limited data suggest a serious negative genetic relationship between size, or growth rate, and fibre production (Shelton, 1981). Selection for fleece weight and/or fleece coverage selects against fertility (Fisk, 1985). The conflict between fibre production and reproduction is, according to Shelton (1978), a serious one.

There appear to be breed differences in resistance to different climatic conditions. Saanen goats with pink skins are reportedly sensitive to strong sunlight and need to be protected from it while Toggenburgs appear to be relatively cold tolerant (Ricordeau, 1981). Angoras appear to be particularly susceptible to cold stress (Shelton, 1981). In South Africa severe losses during periodic cold spells are a serious limiting factor in the mohair industry (Ricordeau, 1981).

Heritability

When breeding goats a number of genetic correlations are of importance. With milking goats total milk production is correlated negatively phenotypically with percent of fat and protein but is correlated positively with total fat or total protein (Shelton, 1978). Body weight tends to be correlated positively with lactation yield (Shelton, 1978). Ricordeau (1981) reviewed the genetics of milking goats (see also Herman, 1982) while Turner (1982) reviewed the genetic principals involved in the selective breeding of fibre goats.

Some heritability estimates are given in Tables 3 and 4. Heritability estimates refer to the portion of phenotypic variance that is due to heredity as opposed to environmental influences. While highly heritable traits are easily subject to effective selection, slightly heritable ones require intense selection to achieve significant genetic progress.

Table 3—Heritability estimates of various traits in milking goats

Milk yield per lactation	0.25-0.64
Fat yield	0.30-0.49
Protein yield	0.59
Fat percentage	0.29-0.62
Coagulable protein content	0.65-0.90
Lactose percentage	0.38
Flavour intensity in milk	0.27
Milking time at machine milking	0.67
Age at first kidding	0.54
Interval 1st and 2nd kidding	0.15
Liveweight at 7 months	0.70
Liveweight at kidding	0.29-0.55
Litter size	0.08-0.24
Birth weight	0.01

Modified from Ricordeau (1981)

Table 4—Heritability estimates for the Angora goat

Lock length	0.59
Fibre length	0.22
Weaning weight	0.33-0.55
Body weight	0.50
Greasy fleece weight	0.40
Clean fleece weight	0.20
Yield	0.48
Fibre diameter	0.12
Staple length	0.79
Face cover	0.31
Neck cover	0.49
Kemp score	0.43

From Shelton (1981) See p.29 for some heritability estimates for cashmere traits.

Artificial Insemination (AI)

The usefulness of AI currently is limited because of a lack of proven production-recorded bucks in this country. However, the technique has been researched widely overseas (eg. Herman, 1982) and Ruakura trials have demonstrated its effectiveness (Goold and Tervit, 1983). Corteel (1981) has reviewed the subject and Goold and Tervit, (1983) have summarised the procedures involved. Improved techniques for storing goat semen are required.

Embryo Transfer

Ruakura staff have developed and described an effective embryo transfer programme (Tervit and Goold, 1983, Tervit *et al,* 1985) see p.18.

The current high prices being paid for Angora goats (see p.24) have encouraged interest in embryo transfer and a number of commercial operations have been established. As ith AI the most severe restraint on progress is a lack of production-tested donors.

Current Research Projects

RA528/03 Artificial insemination of goats with frozen or fresh semen

Proposer: H R Tervit;
Location: Ruakura
Period: Started 1983

Objectives:

To evaluate the fertility of washed frozen sperm or fresh sperm. RA528/02 showed that unwashed sperm decreased in motility during storage in liquid nitrogen and that the pregnancy rate in Saanen does AI'd with this semen was lower than desired. Washed sperm do not decrease in motility during storage and a satisfactory washing system has been developed at Ruakura. Such semen will be used to AI Saanen does. Unsatisfactory results have been achieved after insemination of Ruakura Saanen x feral and feral does with frozen semen. A comparison will be made of the pregnancy rates when such does are AI'd with washed frozen or fresh diluted sperm. Additionally, the effectiveness of intravaginal sponges and controlled internal drug release devices (CIDR's) for synchronising oestrus will be examined in does a number of cycles before the AI programme begins.

Approach:

Saanen does will be synchronised with intravaginal sponges and AI'd at the second oestrus after synchronisation. They will all be AI'd twice with washed frozen sperm, the first AI commencing either immediately after the milking the does are first observed in oestrus or at the next milking. Kidding data will be recorded. Saanen X and feral does will be

treated for 18 days with sponges or CIDR's and their onset of oestrus after device removal recorded. Later in the season the does will be AI'd 48 and 60hr after sponge removal with similar numbers of motile washed frozen or fresh sperm. Kidding data will again be recorded.

Reporting: Annual Reports.

Highlights:

The trials have utilised mainly frozen semen, Saanen or feral does and have shown that:

Kidding rates as high as 45% can be achieved in Saanens after AI at a natural oestrus and 18% at a synchronised oestrus (initial trial conducted in 1982);

Semen unwashed before freezing gives satisfactory post-thaw motilities when thawed shortly after freezing (43%) but the motility falls over the following two months storage to around 25%. This fall in motility during storage can be counteracted by washing the sperm before freezing or by not-washing but using a diluent containing a high egg yolk level.

Recent studies with what appears to be very good frozen-thawed semen have given very disappointing results in Saanens and ferals. Because the work was considered low priority, the inseminations were often done very late in the breeding season. This could have contributed to the poor results (0%—33%). However, insemination of Saanens during the 1983 breeding season also gave poor results (7%). A satisfactory pregnancy rate (63%) was achieved in synchronised Saanens inseminated in 1984 with low numbers of frozen-thawed sperm placed into the uterus via an endoscope. This indicates that, as in the sheep, the poor fertility after inseminations of frozen sperm via the cervix is due to problems with site of sperm deposition coupled with reduced sperm motility.

RA528 Embryo transfers in goats

Proposer: H R Tervit;
Location: Ruakura
Period: Started 1979

Objectives:

To develop effective embryo transfer regimes for Saanen and Angora donors. The recent increase in interest in goats has lead to a demand for the rapid multiplication of valuable does. This can best be met through the technique of embryo transfer. This technique is not widely researched overseas and so this project examines various hormone treatments and factors affecting the success of embryo transfers.

Approach:

Donor Angora does will be synchronised with either progestagen-impregnanted intravaginal sponges or daily intramuscular progesterone injections and superovulated with pregnant mare's serum gonadotrophin (PMSG) or follicle stimulating hormone (FSH). Embryos will be recovered by flushing the donor uterus about five days after mating and then transferred to synchronised recipients. Each recipient will receive either one or two embryos. The recipient kidding will be closely supervised and the total kidding performance of the donors, (ie, recipient kidding plus donor re-breeding) recorded. The most effective treatment will be used on Saanen does.

Reporting: Annual Reports

Highlights:

Research in this project has seen the development of a very effective hormone regime for superovulating both Angora and Saanen does, (eg, Angoras shed, on average 15.1 eggs and Saanens 29.3). The eggs are virtually all fertilised and embryo recoveries, using a uterine flush technique developed for sheep by Tervit and Goold, are high with minimal effect on the donor's ability to rebreed. Also, factors affecting the pregnancy rate and embryo survival in recipients have been identified and recipients are now routinely twinned (or tripleted) with both embryos in twins transferred to the uterine horn adjacent to the corpus luteum bearing ovary. Importantly, it has been shown that synchronisation of donor and recipient oestrus is nowhere near as critical to success as it is in the sheep or cow.

Oestrus control in goats

Proposer: R A S Welch, P Haszard
Location: Ruakura

Objectives:

Synchronisation of oestrus in does saves labour where AI and/or embryo transfer is to be

performed. AI techniques using either fresh or frozen have been developed overseas. AI allows:

1. Introduction of genes from overseas with fewer quarantine problems and at a low cost.

2. Sire referencing across a number of farms would help to identify superior sires. This has relevance for dairy, cashmere and Angora goats.

3. Rapid spread of genes from outstanding sires.

RA578/13 Immunisation of goats (in order to increase ovulation rate)

Proposer: J F Smith;
Location: Ruakura

Objective:
To investigate the effects of Fecundin® and a Ruakura oestrone antigen on ovulation rate in goats.

Approach:
Two preliminary trials each involving 10 treated and 10 control does were conducted with feral and Saanen does using either 'Fecundin' at the sheep dose rate or the Ruakura oestrone antigen (prepared by R J Fairclough

Reporting: Annual Reports

Highlights:
In both trials although elevation of antibody titres were achieved no increase in ovulation rate above the control levels of 1.50 in the ferals and 2.00 in the Saanens. The elevation of titre levels required two booster injections instead of one, ie, a three injection regime and the trials were conducted at the extremes of the breeding season (due to priority given to sheep trials).

PM 43 Shearing Policies and Fertility in Feral Goats in Wanganui

Proposer: A J Litherland
Location: Wanganui Hill Research Area
Period: May 1985

Objective:
To obtain data on the effect of mating dates, shearing dates and level of nutrition on reproduction rates in feral goats on hill country.

Approach:
Treatments tested—3 kidding dates 2 shearing dates 2 liveweights one month pre-mating

GOATS FOR WEED CONTROL

While goats have, in a number of trials, (eg, Anon, 1924; Fawcett, 1925; Wright, 1927; Guthrie-Smith, 1929; Hill, 1939), proved effective in clearing scrub the relevance of this facet of the industry in relation to the others (meat, fibre and milk) has not been clearly established. It appears that in considering this point it is essential to establish priorities and that if goats are wanted primarily for weed control there is a reduced likelihood of significant secondary production being harvested from the herd (see Batten, 1984c). The dilemma is that poorly nourished animals will produce poorly but if they are well fed they will control weeds less effectively.

At Ballantrae goats have successfully controlled regrowth gorse up to 2m high, scattered manuka, barberry and blackberry (Rolston *et al,* 1981; 1983; Lambert *et al,* 1981; Clark *et al,* 1982). In addition thistles (Scotch, marsh, Californian and winged) which were grazed by goats as flowering began, failed to produce seeds (DSIR 1984). Radcliffe (1982, 1984) has also reported successful use of goats for gorse control. She found that at Loburn, North Canterbury, goats rotationally grazed at a stocking rate of up to 35/ha reduced previously burnt gorse to negligible levels over a two year period. Sheep and goats mixed (ratio of 2:1) rotationally grazed at a comparable stocking rate were equally successful. In addition she found that stands of dense unburnt gorse up to 2m high were reduced from 66% gorse cover to 7% using 44 goats/ha set stocked for one year.

Trials run by the Department of Lands and Survey in the South Island have demonstrated that goats can control sweet briar. Those trials compared Angoras, feral goats and Merinos at stocking rates of 10:14:12 per hectare respectively (Morton, 1985). The goats controlled the sweet briar, they did not lose weight unlike the Merino and the Angoras produced sufficient mohair to provide a gross return of about $390 per hectare per year.

Other plants eaten are tauhinu, broom, kanuka, heath, tutu, sweet briar (McKinnon, 1982), willow, ragwort, fern, rushes and sedges (Batten, 1984c). Manuka is preferred to kanuka as forage and if kanuka predominates in a block goats may prove

Invermay feral goat herd. The cage contains the weed regrowth that has occurred where the goats are not grazing.

unsuitable for control (Batten, 1984c). Poisonous plants are listed in Appendix I.

Stocking rates to be employed will vary according to the vegetation but a maximum of about 16 ge/ha of total weeds is probably practical (Batten, 1984c). However, Rennie (1976), reported a claim that about 75 goats per hectare are required to effectively check blackberry and that even when set stocked they will not eradicate it. The minimum rate reported by Batten (1984c) as holding weeds from encroachment is 6 ge but this should be used as a guide only. Goats are thought to be most effective when they are able to continually browse over a block rather than when very heavily stocked for a short period (Batten, 1984c) but further work is required on this area of management.

Where feral goats and crossbred Angoras have been used in weed control programmes in Northland some farmers have found that crossbred stock did not fare well. It is therefore, probably more appropriate to use feral goats for the first two-four seasons then to embark on a crossbreeding programme. This scheme would also help to eliminate some of the problems associated with vegetable matter contaminating mohair (Horton, 1982).

Comparisons between goats and sheep grazing grass/legume pastures in New Zealand have shown very marked differences in the proportion of legume dry matter in the herbage remaining after 18 months of grazing. Areas grazed by sheep alone contained only 10 percent of white clover whilst those by goats alone contained 80 percent of clover (R J Wilkins cited by Wilkinson and Stark, 1982).

Lambert *et al,* (1981) at Ballantrae, near Woodville, also reported that farmed feral goats prefer not to graze white clover and that a high degree of clover dominance can be achieved by goat grazing.

This ability of goats to improve pasture could be utilised on developing dairy farms where pasture weeds require attention.

Batten (1984c) strongly recommended that wethers be used against weeds. He suggested that income could be based on a breeding herd farming weeds which could, in turn, produce wethers for use in breaking-in new pasture.

For effective goat-based weed control it is essential to have secure fences. Electric fences, used after suitable animal training, are most appropriate with a single outrigger wire at 25 cm above ground being satisfactory (Batten, 1984c; see also Rumble, 1985).

Farm goats should be branded either with a registered earmark or a hornmark. Proper identification is essential and required by law to

differentiate domestic animals from wild goats which are classified as noxious animals (Batten, 1984c). Methods for branding and marking are given by Gibbons *et al,* (1984) while tattooing is described by King (1980).

Economics of Weed Control Using Goats

The economic advantage of using goats to control weeds is difficult to evaluate because of variations in costs and income from goats. Generally where emphasis is placed on goat income less weed control is achieved because managing goats to reduce weeds creates stresses that reduce animal production (Batten, 1984c).

Presently the limiting cost is likely to be that of stock with fencing costs being a secondary consideration. Fawcett (1925) reported that 'goats have been farmed in Waimea County (Nelson district), solely for use in the control of blackberry, since 1906. The results claimed by their owners have clearly demonstrated that at present these animals are the most economical agents known for combating the pest'. Subsequent work by Rush (Anon, 1924), Wright (1927), Guthrie-Smith (1929) and Hill (1939) confirmed this belief and extended the acknowledged range of weeds which goats will control to include gorse and bracken. Today goats are still the most economic agents for weed control when they can be purchased (and/or sold) at the right price.

Krause, Beck and Dent (1984) assessed a range of weed control options involving goats or goats and sheep as compared with the burn and spray method. They concluded that strategies using goats, with or without sheep, were the more economic options in their simulation.

Nationally, goats could currently be worth about $20 million pa in their role as 'reversion controllers'. This figure is based on the assumption that there is a $200 million reversion factor operating and that chemicals for weed control cost $50 million pa to import (M Horgan, pers comm).

Within the developed world appreciation of 'pure' and 'natural' foods is increasing. In conjunction with this, a phobia of environmentally polluting chemicals, particularly insecticides and herbicides, polluting the environment is developing. In this context either substituting goats for herbicides or adopting an integrated approach, reliant on fewer and less chemicals, appears to have considerable potential. However, escapees invading Crown Land are difficult and expensive to control and, in turn, threaten the environment.

Goats utilising 'weeds' as forage

Given a choice, goats prefer browse plants (Devendra, 1978). However, they can also use both pasture and fodder grasses and other roughages such as cereal straws just as efficiently, especially if browse plants are not readily available (Devendra, 1978).

According to Batten (1984c) stocking levels of around 6 ge/ha of total weed cover will keep weed growth static and provide income in the form of meat or fibre. Aspects of scrub-browse utilisation in productive goats are being examined in the Nelson and Canterbury regions of the South Island by ARD and in the Southern North Island by ARD and DSIR.

A number of trials have been reported where weed control and production of goat products have been successfully combined. Angoras have been used to clear sweet briar (McKinnon, 1982, Morton, 1985), meat has been produced as a 'by-product' of weed control (Crouchley, 1980; Every, 1980) and milking goats have been used to break in gorse and scrub land (Little, 1974).

It appears that some of the more geologically unstable hill country would lend itself to a farming system employing more shrubs and trees—so long as herd management was efficient.

A problem relating to herd management of productive goats on extensive hill country blocks is that of goat behaviour. The rapid reversion of farmed goats to 'feral habits' could prove troublesome. However, the problem of handling would probably be reduced where sheep were included in the system or where the stock were regularly herded.

Current Research Projects

LC011/01 Gorse control with goats and goat parasite studies in gorse/pasture associations

Proposer: J E Radcliffe;
Location: Ellesmere
Period: Started 1984 finish 1986

Objectives:

1. To evaluate gorse control by goats when gorse has been allowed to develop following burning and sheep grazing.

2. To examine the seasonal pattern of a nematode/egg output in goat (and sheep) faeces when goats are confined to gorse and pasture associations. These data will provide basic information on which to formulate strategies for parasite control.

Approach:

Areas of 'tall browse' (gorse 1 to 2m high), 'short browse'/pasture (gorse less than 1.0 m high), and pasture will be set stocked with dry feral goats or dry Angora x feral goats. In addition dry sheep and dry goats in a 1:1 ratio will be set stocked in a 'tall browse' area with pasture. Faecal egg counts will be monitored monthly and gorse populations monitored yearly.

Reporting: Annual Reports

Highlights:

Upto March 1985 all stock continued to have low egg burdens, following drenching in October 1984.

LC011/02 Maintenance of gorse free pastures

Proposer: J E Radcliffe;
Location: Ellesmere
Period: Started 1984 finish 1986

Objectives:

To determine whether land which has been developed out of gorse by burning, oversowing and grazing with goats for four years can be maintained in a gorse-free state, by grazing with sheep only, or sheep plus a small complement of goats.

Approach:

Use gorse-free, areas which have been developed from four years of goat grazing management studies at Loburn, under project CB29. Compare two stock treatments, sheep only, or sheep plus a small complement of goats; with two grazing managements, set stocking or rotational, with two replicates. An additional treatment of sheep only, set stocked will be unreplicated.

Reporting: Annual Reports.

Highlights:

Rotationally grazed pastures still appear to be gorse free (March, 1985), but under set-stocking with sheep only, gorse is making a strong recovery.

CB 029 Control of gorse with sheep and goats

Proposer: J E Radcliffe
Location: Loburn, North Canterbury
Period: Started 1981

Objective:

To compare the effects of dry goats or dry sheep grazed alone or together on burnt gorse using either rotational grazing or set-stocking.

Approach:

Stocking rates have operated on the basis of two goats = one sheep.

Reporting: Annual Reports

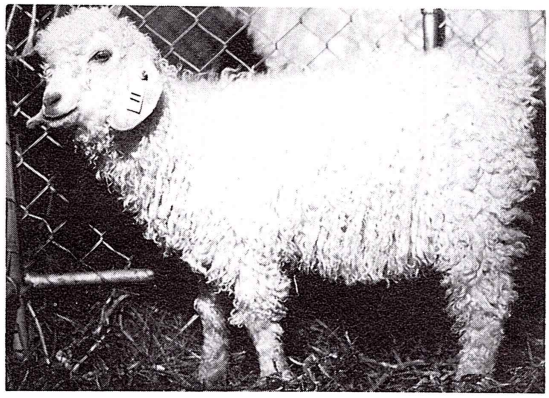
Highlights:

After three years, gorse has been reduced to negligible levels under rotational grazing or set-stocking with goats and rotational grazing with a sheep/goat mixture. This latter treatment had potentially the most productive pasture with most ryegrass and least weeds. All goat grazed pastures contained appreciably more clover than did sheep pastures. Under sheep/goat set-stocking, gorse bushes have become dense and spreading although they are kept short by browsing.

In October 1982, the four most successful treatments in terms of gorse control (goats only or sheep/goats rotationally grazed and set-stocked) were replicated on a nearby gorse area, which received a dessicant spray before burning in April 1982. In all these treatments, live gorse was reduced to negligible levels after one year.

In three other treatments, the effect of goats, set-stocked on the original, dense, unburnt gorse has been studied. Three to four years of intensive goat grazing, with at least 20 goats/ha have reduced live gorse to very low levels. Sustained goat grazing pressure, is however, necessary to kill the gorse. This process was hastened by the ingress of fungal pathogens into gorse stems following ring barking.

FIBRE PRODUCTION



Product: Mohair

Mohair is the fibre produced by Angora goats. It is a relatively long (100-175mm) high lustre white fibre with a mean diameter of 19-45 microns.

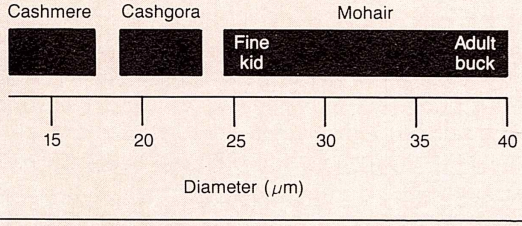
Fleeces from Angora goats can contain up to four fibre types (Turner, 1982):

—non-medullated fibres
—'heterotype' non-medullated fibres with medullated tips. Have been called 'gare' fibres
—medullated fibres (containing a core of air)
—latticed fibres known as 'kemp'. These fibres are opaque and white in colour.

High quality mohair contains little or no medullated or kemp fibres since these do not absorb dye well and are unsuitable for manufacturing most mohair derived products.

Bigham (1985) illustrates fibre diameter differences between mohair, cashgora and cashmere in Fig. 1.

Fig. 1—Diameter Ranges of Goat Fibres



From Bigham (1985)

Top grade mohair is obtained by shearing kids at about 6 and 12 months of age when the maximum diameter is about 30-33 microns. As goats age, the average diameter of of mohair increases. Processing requires fibres 130mm or greater in length.

Shearing methods and handling facilities are described by Rumble (1985).

Average annual production from Angora kids is about 1 kg and from does, 2-3 kg. Crossbred (Angora x Feral) does produce 1-2 kg depending upon the stage of upgrading.

Trade

Mohair is a 'luxury' fibre, often blended, and used to make clothing and furnishings. Latest estimates (1984) of world production are 18-20,000 tonnes. In 1965 production peaked at 30,000 tonnes, a level regarded as an over-supply situation. By 1971 it had slumped to 13,400 tonnes.

In the 1983/84 season the main producers (all arid areas) were South Africa (8200t), Texas (4300t), Turkey (3000t), Argentina (1000t), Lesotho (600t) and Australia (350t). Australia is now becoming a significant mohair producer and expects to produce about 3500t by the late 1980s.

According to the Chief Executive of the South Africa Mohair Board the current level of mohair production cannot meet world requirements. Mohair prices do fluctuate but traditionally mohair has been worth more than wool. In recent years it has been valued at substantially more than wool as a result of fashion demand and reduced world production. South Africa and Lesotho have recently been adversely affected by drought and in Texas there is a growing predator problem so the capacity of these producers to increase production is doubtful at least in the short term. Political problems in South Africa are unlikely to aid that country's marketing difficulties.

New Zealand Situation

Mohair production in New Zealand has increased since 1981/82 from 6t to 35t for 1984/85 with a forecast of 45t for next year. At the recent pool sale (reported 'Dominion' 31.5.85) the average price was $21/kg. Mohair prices range from $30/kg for A kid to $12/kg for B 2nd does. Cashgora A sold for $75/kg. On a world scale New Zealand production represents less than 0.2% of world production. By

Table 5—Mohair Production Parameters

Grade of Goat		G4	G3	G2t	G1	Angora
Fibre diameter	Kid	17-21	20-24	22-27	24-28	25-28
(microns)	Adult	20-23	22-26	24-30	26-32	26-36
Price $/kg	Kid	60.00	12.50	14.50	14.50	25.00
	Adult	15.00	12.50	10.00	10.00	16.00
kg/year	Kid	0.5	0.7	1.2	1.6	2.0
	Adult	1.0	1.5	2.0	2.5	3.0
Return/goat	Kid	30.00	8.75	17.40	23.20	50.00
	Adult	15.00	18.75	20.00	25.00	48.00

Source: Woodward, 1984 AGM MoPANZ

1990 sale of mohair is expected to be $2.5-5.0 million compared to about $0.74 million this year.

The process of upgrading ferals using Angora bucks results in the production of cashgora. This fibre is finer than mohair and falls between cashmere and mohair.

A range of specifications, values, production and dollar returns is shown in Table 5. The grade of goat identifies the number of generations away from being regarded as a pure bred, ie, G4 is 4 generations prior to Angora.

G J Batten (pers comm) considers that the figures quoted above for adults are about 0.5 kg higher than can be reasonably expected from goats run commercially on hill country, (ie, G3 should be 1 kg and Angora 2.5 kg). The above figures came from goats held under intensive stud conditions where nutrition was more than adequate.

The 1983 census reported 6599 purebred Angoras in New Zealand predominantly female (70%) and in the North Island (60%). Angora crosses totalled 30,838 mostly in the South Island (55%). These numbers are increasing rapidly by upgrading ferals and by 1990 could number 250,000 Angora type goats. At an average mohair production of 1.5 kg the clip would total 375t worth, at 1985 prices, over $7 million. Since current prices are derived from flocks undergoing upgrading and therefore producing less than top quality fibre it is reasonable to assume that the price/kg will increase. The current investment in the mohair industry in New Zealand is estimated at $43 million (Cooper, 1985) largely due to current high value of stock.

Angora shearing, with the fleece being sorted.

Sales of Angora goats in 1985 have seen extraordinary high prices, the highest being $140,000 for a 2-tooth buck from the Waitangi Angora Stud (Lands and Survey Department), At this sale, 2-tooth maiden does sold for as high as $40,000, the average for 248 head being $20,613.

Wrightson-NMA are planning to import 2000 Angoras from Australia thereby increasing the pure-bred pool substantially.

determine suitable management techniques, measure reproduction rate, liveweight gain and mohair production.

Approach:

150 feral does mated to Angora bucks with progeny upgraded by further crossing.

Highlights:

Management

—easily contained by electric fences
—do not consume much clover
—eat grains, wheat straw, kale
—prefer blackberry, broom, gorse, docks, thistles, rank grasses, hay
—iodine deficiency apparent when grazed on soft turnips/rye grass

Reproduction

—kidding rates vary between ages and season from 52-145%

Fleeces

—average G2 does produce annually about 1.1 kg of fleece with an average fibre diameter of 22.1 microns

Future work:

—further crossing to purebred Angora status
—continuing comparisons of different ratios of sheep:goats and the effect on pasture composition
—selection for high and low kemp
—measuring effect of doe mating weights on kidding rate
—when pure-bred Angora status achieved selection for kidding rate, mohair yield and quality will begin
—frequency and rates of drenching for parasite control

RW 174 Goat Fibre Production

Staff: M L Bigham

Location:

Whatawhata Hill Country Research Station, Waitangi Angora Stud, Adair Research Station

Period: February 1984—May 1992

Objectives:

To obtain genetic data for production traits for cashmere and mohair; To obtain basic data for management of a goat flock on hill country.

Approach:

Whatawhata: Two flocks are being set up to compare the upgrading routes of ferals to Angoras, ie, recommended backcrossing with interbreeding first cross (G4) Angora x feral selected for mohair.

Waitangi: Genetic estimates from fleece data, liveweights, fertility in collaboration with Dr G M Nicoll of Lands and Survey Department. This Waitangi data is derived from 21 sire-progeny groups and currently is the only source of NZ data. It is planned to extend this work using Angora flocks in the Waikato. To date four breeders are co-operating.

Highlights:

—Preliminary heritability estimates on some parameters have been made (p.25) on Waitangi goats.

—Last six seasons kidding has averaged 145% ranging from 124 to 160%.

—Average annual mohair production for kids, does and bucks has been 2, 3 and 4 kg respectively.

—Kid mohair has been sold to local spinners at $9/kg.

—Foot scald has been most serious problem but can be treated by trimming and chemicals.

—Successful technology for embryo transfers developed to increase flock size.

PM 44 Monitoring Fibre Growth in G3 and G4 Angora Does

Staff: A Litherland, W Dyson, D Wright

Location: Levin Horticultural Research Centre

Period: July 1985—July 1986

Objective:

To quantify mohair/cashgora growth throughout the year.

To evaluate two different techniques of measuring fibre growth on G3 and G4 Angora does.

Approach:

Fibre growth will be measured using midside patches and dyebanding techniques on opposing sides of the same goats. Measurements will be repeated at monthly intervals on 80 G3 and G4 Angora breeding does.

Product: Cashmere

Cashmere is regarded as the most expensive

The local goat industry infrastructure is undergoing development and currently involves a New Zealand Goat Council which includes representation from the Mohair Producers Association (MOPANZ) and the Cashmere/Mohair Warehouse. The latter warehouse, located near Pukekohe, provides a central location for combining grading and marketing goat fibres. Relatively little mohair is processed in New Zealand. The President of MOPANZ recognises that the Association must be involved in planning industry development including research needs.

Two agencies offer fibre testing services in New Zealand. These are the NewZealand Wool Testing Authority (Head Office, 222-236 Willis Street, Wellington) and Wool Testing Services New Zealand Ltd (Head Office, 124 Park Road, Miramar, Wellington).

As of July 1985 prices for tests were:

Mohair

1. Fleece Measurement Washing yield and mean fibre diameter $5.00
2. Medullation Count To determine the proportions of heterotype fibre (kemp), medullated and non-medullated fibre $15.00

Cashmere

The NZWTA acts as an agent for the Australian Wool Testing Authority to whom all samples are sent.

Charges, per sample:

1. Diameter only—FFDA method $11.00
2. Yield only (1-50 samples) $16.00
3. Yield only (51+ samples) $13.00
4. Package (yield, diameter and subjective colour) $21.00

Wool Testing Services charge $45.00 for projection microscope measurement of cashmere.

Cashgora is currently a major product of the goat fibre industry and may be recognised as a unique fibre with its own particular qualities for processing. As flocks become registered as Angoras with mohair production the goal, it seems likely that cashgora production will in the long term become less important.

Since New Zealand has only a small pool of Angora genes the rate of industry expansion depends upon utilising a larger (estimated at 400,000) pool of feral goats and technology such as super-ovulation, artificial breeding and embryo transfers. Some use is made of dairy goats to increase goat size.

Four crosses are required to achieve pure-bred. Concern has been expressed that the hardiness of the New Zealand feral should be retained in New Zealand flocks for example by using Angora bucks for 2-3 generations followed by 3/4 or 7/8 Angora bucks.

In the absence of performance based selection parameters, current criteria for selection include conformation, size and colour, 'high' survival rate, 'good' reproduction rate, 'satisfactory' annual yield of mohair and 'reasonable' growth rate (Aglink FPP354). Extensive data on these production parameters are not yet available to guide the industry.

Nicoll (1985) has calculated heritabilities from over 1000 young Angora goats from 15 sires at the Waitangi Stud. His data show:

—males are heavier than females at weaning and had heavier fleece weights at 6 and 12 months;

—weaning weights have heritability of 0.28, 12-month fleece weights of 0.4, yearling (6 and 12 month combined) fleece weights of 0.53;

—no antagonistic correlations between weaning and fleece weights.

No estimates of heritability for reproduction, maternal ability or fleece parameters such as fibre diameter have yet been made in New Zealand.

It is reported (Fisk, 1985) that South African research shows negative correlation between fleece weight, fleece cover and fertility suggesting that selection for fleece weight and cover would reduce fertility. It is also reported that Texan studies show high heritability for fibre length whereas in South Africa this trait has a low heritability.

Current Research Projects

RT 152 Investigation of Angora goat meat and mohair production

Staff: CCS McLeod,
Location: Adair Research Station, Timaru
Period: Started 1979, finish 1987

Objectives:

To upgrade feral does with Angora bucks,

Feral type goats showing cashmere.

natural fibre for processing into fabric for expensive clothing, rugs, scarves and even carpets.

Cashmere combines lightness with warmth and despite the fineness of its fibre it is hardwearing. Its value does not seem to be affected significantly by fashion trends.

Dawson International, one of the worlds largest processors of cashmere defines the 'ideal' fibre as follows:

—average diameter of 15-16mm with a range of 8-24mm;
—down length of 50-55mm with a range of 10-70mm for woollen systems or 19-100 for worsted systems;
—no medullation in the down;
—guard hairs should be at least 60mm in diameter with fleeces containing no hairs of 30-60mm;
—fibres have no crimp, neither are they straight;
—low grease content of 2% or less.

Cashmere-type goats produce fleeces containing both down (cashmere) and guard hairs, the latter being mechanically removed. Cashmere quality is defined by colour (white is preferred), average fibre diameter, range of fibre diameters, length of fibres, presence of impurities and grease content.

Typical mean fibre diameters and fibre length for kid, fine adult and medium-fine adult grades are 16.5, 17, 17-19mm and 35, 40, 40mm respectively.

White cashmere receives top prices. Other colours are cream, grey and brown. The minimum desirable fibre length for processing is 40mm. The industry believes the finer the fibre the lower its production weight and conversely the stronger the fibre the greater the fleece weight. As a general rate the coarser fibres receive lower prices.

Production figures quoted for down vary greatly. Publicity material from the Cashmere Producers of NZ (CAPRONZ) quotes 50-70gm from feral does, 100-150gm from selected ferals, 250gm as a short-term selection goal with 500gm as a medium-term goal. An average annual production of 200gm/head is believed to be a realistic target. A recent MAF Situation Report quotes 20gm from unselected feral goats in Northland.

Australian cashmere-bearing goats can produce 300-400gm of total fibres containing 80-120gm cashmere of 16-17mm diameter. Selected ferals have produced up to 170gm cashmere.

Limited Australian data show that selection of goats for cashmere can be expected to increase production of this fibre as follows:

F1, 125gm; F2, 150gm; F3, 180gm; F4, 200gm. Realistic fibre production from F4 bucks, adult does and 2-tooth does are 250, 200 and 140gm of cashmere respectively. Little data is available from NZ goats.

Trade

Total world production of cashmere for 1982/83 was 4500t with 6000t the current estimate. The major producers are:

China—2500t, mean diameter 15-16mm
Mongolia—1000t similar to Chinese product
Iran—1000t, 17-20mm, longer fibres
Afghanistan—output not known but similar quality to Iranian cashmere

Australia in 1983 produced 23t, 8t in 1982. Average production per goat was 270gm from a population containing 50,000 adult goats. Australian cashmere is in the range 12-19μm.

Worldwide there are about a dozen cashmere processors, the 'big four' in UK, USA and Italy (2) processing 85% of the world production. Demand consistently exceeds supply so prices have been high and stable.

Current prices offered are shown below (Table 6):

Table 6—Value of Cashmere

	$/kg cashmere		
µm	white	grey	brown
15-16	169	126	92
18-19	92	54	35

New Zealand Situation

In New Zealand cashmere is obtained from feral goats. At the May 1985 meeting of CAPRONZ it was estimated that last seasons production from members of CAPRONZ (278) was about 9 tonnes valued at $120,000, ie, about $13/kg of fleece.

CAPRONZ is seeking by 1990, 1000 members farming 600,000 goats producing 55t of cashmere valued at $6 million. A 10 year forecast has been prepared on a 1985 base of 160,000 goats, 20% culling, continuing feral capture for another seven years, 75-100% kid survival, and 80g of cashmere down per goat. This is based on only goats with heavy fleeces being shorn, ie, from second year after capture. The 1995 forecast is 4 million goats, 65% female, average of 220g of cashmere/head providing 650t of down worth at 1985 prices $100m, ie, $153/kg.

CAPRONZ was established in 1984 to represent cashmere producers and to develop the cashmere industry. It has an elected executive committee, it organises an annual conference, it has identified broad areas of research needed to help the industry, it has set production targets and identified a need for public/private sector collaboration for developing a significant export orientated industry.

There is no general agreement about the best route for upgrading feral goats for cashmere production. Two methods are being used, the first is selection for cashmere (weight/quality) within feral flocks and the second, the so called G4 route in which feral does are mated to a first cross Angora x feral buck with the resulting generations of progeny being interbred and selected for cashmere.

There is no such goat as a cashmere goat in New Zealand—some animals, even dairy-type goats grow cashmere fibres with yields varying greatly. Only some ferals produce cashmere so these animals need to be identified and used in breeding programmes. There are no data comparing the rate of genetic progress for these optional breeding routes.

It is current CAPRONZ policy to recommend using the 'feral' route because of the processing problem of dehairing fleeces from crossbred goats. Proponents of cross breeding with Angoras argue that productivity in terms of fleece is markedly increased. Bigham at the 1985 Ruakura Farmers Conference expressed doubt on this view claiming that these data were based on a small number of goats in a trial where the groups were sired by different feral bucks. One obvious advantage for cross-breeding is the influence of Angoras on ensuring all progeny produce white fleeces which are more valuable than coloured fleeces. Another breeding strategy is to mate feral bucks to feral x Saanen does which will have increased size and lactation ability. There seems to be no available data on this route.

Cooperative schemes analogous to those used in the sheep breeding industry are being advocated by CAPRONZ allowing selection of best sires and central mating to selected does. In one group cited by Bigham (1985), five bucks with production greater than 200gm cashmere have been selected from an initial selection group of 80 bucks.

The relatively coarse fibre produced by crossing Angoras with cashmere-producing ferals is described as cashgora. This fibre intermediate between cashmere and mohair has fibre diameters between 19-23um. It has been described as a 'new' natural fibre for the international textile industry and may well prove to be a major identifiable valuable product. Since it is the initial product from upgrading ferals its production volume will increase and then decline unless strategies are developed to maintain a constant supply to processors.

There is a need for market research on cashgora and the development of production strategies in the event that long term markets appear profitable.

There are no New Zealand genetic data on cashmere production and quality. Australian data (Pattie and Restall, 1985) is shown in Table 7.

These data show that reasonable progress in improving the above traits can be expected from selection. A positive correlation exists between

Table 7—Heritability estimates for cashmere	
Down weight	0.60 ± 0.19
Fibre diameter	0.48 ± 0.17
Fibre length	0.89 ± 0.24
Liveweight	0.43 ± 0.16

cashmere weight and fibre length so indirectly the latter could be used to select for cashmere weight.

Negative genetic correlations have been found, ie, selection for down weight on fibre length will undesirably reduce liveweight and increase fibre diameter.

Bigham's overseas travel report on his October 1984 visit to Australia summarises that country's research on cashmere production. He considered that much of their work is relevant to the New Zealand industry and stated he sees 'little need for a large research effort into cashmere production in New Zealand'. Rather the approach should be to characterise New Zealand's cashmere-producing goats so that the Australian data can be transferred to New Zealand. This will need a close liaison between New Zealand and Australian research effort.

In summary, Australian cashmere research for developing an industry based on upgrading ferals as in New Zealand involves:

—genetics of cashmere production and carcass composition;
—application of the crossbreeding (G4) route for cashmere production;
—development of techniques for ranking goats for production;
—nutrition of the cashmere goat;
—effect of stocking rate and mixed grazing with other livestock species;
—hormonal control of the cashmere growth cycle;
—development of immune responses to internal parasites.

At the 1985 meeting of CAPRONZ research priorities were seen as:

—establishing seasonal feed requirements for maintenance and production;
—identification of 'most desirable' plant species for adequate nutrition;
—establishing phenotypic and genetic relationships;
—development of AI technology;
—maximising cashmere harvesting;
—integrating weed control with fibre production;
—developing management systems for mixing goats with other livestocks;
—developing indirect selection for cashmere weight;
—understanding primary and secondary follice development;
—understanding and manipulating immune systems in goats;
—identifying best drenching strategies for internal parasite control;
—establishing fibre testing methods and facilities;
—developing fibre processing especially dehairing;
—obtaining and disseminating market information.

Current Research Projects

RW 174 Goat fibre production

Staff, location, period, objective (see Mohair section).

Approach:

The original project (1984) planned to compare upgrading feral does for cashmere by the G4 or feral selection routes. This has been changed to an on-station trial comparing single trait selection in ferals as follows:

(a) control;
(b) selected for increased cashmere weight;
(c) selected for decreased fibre diameter.

Progress: Has just begun.

RW 174/1 Goat fibre production : cashmere goat production on commercial farm

Staff, period, (see Mohair section).

Location: Various farms

Objectives:

To obtain the following data from commercial cashmere flocks:

—cashmere production in feral goats in New Zealand;
—compare different breeding routes;
—identify, and measure fleece and body traits important in G4 buck selection;

—obtain genetic and phenotypic estimates for cashmere production and determine influence of Angora and Saanen genes on these estimates.

Approach:

1. G4 buck selection—from 200 G4 bucks, 28 have been selected subjectively as suitable as sires. All 200 bucks will have fleece/fibre measurements taken.

2. Selected G4 and selected feral bucks will be progeny tested to compare progress between these two routes.

3. Genetic data will be obtained from (2) above and from other commercial properties to provide heritability estimates and relationships between age, fertility and cashmere weight.

Product: Common Goat Hair

Common goat hair is medullated fibre ranging in diameter from 40-140mm and can be up to 10 cm long. It occurs in a range of browns and blacks through to white and more than one colour is frequently found on an animal. It is usually associated with the primary follicles and is found on all goats except the Angora (Holst, 1982).

Long goat hair is used by villagers to make rope, bags, mats and carpets. Such products are largely used in their countries of origin.

Goat hair is used commercially in the manufacture of felts, cords, carpets and brushes (Holst, 1982). It may also be used for interlinings and occasionally as a substitute for kemp to produce fancy effects in tweeds (Kirton *et al,* 1985).

Trade

Pakistan is a major exporter of goat hair and has developed a grading system based on colour and fibre length. Annual production is about 3,500 tonnes (Holst, 1982).

Australia imports 2,000-3,000 tonnes of goat hair annually for use in the manufacture of industrial felting and carpets (Holst, 1982).

MEAT PRODUCTION

While more than twice as much sheep meat is produced worldwide compared with goat meat (416,640,000 tonnes c.f. 175,969,000 animals FAO 1983 figures; FAO 1984), more people eat goat meat (Batten, pers comm). Goat meat (chevon) is a preferred meat in many countries, especially in Africa and Asia. There are no known religious taboos preventing people from eating goat meat (Holst, 1982) and in many countries goat meat is sought after for religious festivals (Hughes *et al,* 1983). World production figures for 1983 are given in Table 8.

Table 8—Goat meat and skin production for 1983 (FAO, 1984)

	Number (1000s)	Mean Carcass wgt (kg)	Weight (1000s tonnes)	Skins (tonnes)
World	175,969	12	2043	405,708
NZ	53	20*		
Africa	52,004	12	611	108,920
N & C America	2,940	10	30	7,653
S America	5,484	12	64	13,935
Asia	104,908	12	1,226	253,951
Europe	8,544	10	84	12,773
Oceania	89	17	1	196
NZ% of world prodn.	0.03		0.05	0.03

**The FAO figure is too high and A H Kirton (pers comm) suggests that 10 kg would be a more accurate estimate.*

Goat meat differs from other traditional ruminant meats in that is is almost devoid of subcutaneous fat (Naude and Hofmeyr, 1981). Both the digestible protein and energy contents of goat meat compare favourably with those of other species (McDowell and Bove, 1977).

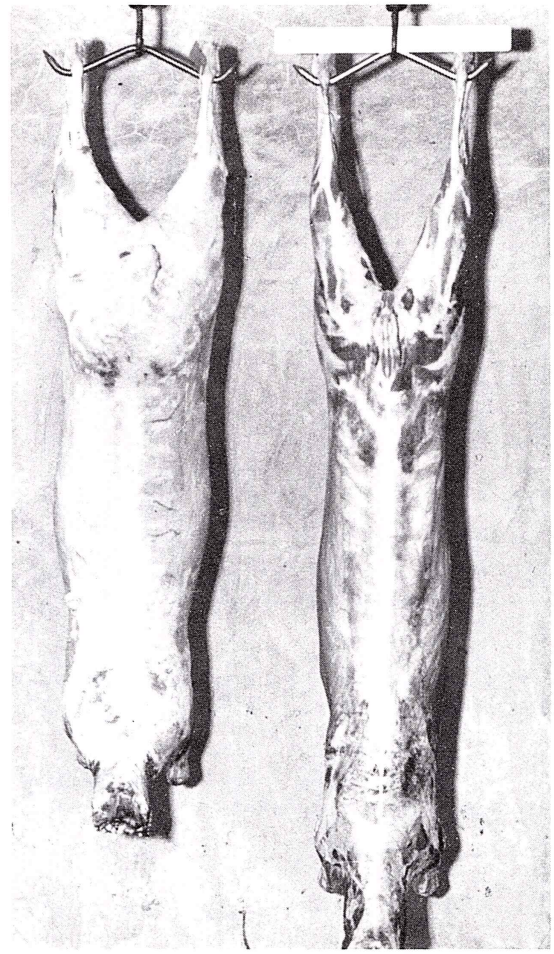
Taste panels, both in New Zealand (Kirton, 1970) and the Sudan (Gaili *et al,* 1972) found a tendency for goats' meat to be tougher than mutton but no major taste differences were detected. In a test carried out in Australia, students were unable to distinguish goat from hogget mutton (Foley *et al,* 1981).

Carcass composition has been reviewed by McDowell and Bove (1977), Naude and Hofmeyr (1981) and Gall (1982). Kirton (1970), examined the body and carcass composition of feral goats in New Zealand and reported dressing percentages of 44.6 and 42.2 for male and female goats respectively.

The carcasses of castrates are fatter and the lean meat has less flavour than that of intact males (Naude and Hofmeyr, 1981).

It is likely that electrical stimulation of goat meat will have a tenderising effect comparable with that recorded with sheep meat but work remains to be done in this area (A H Kirton, pers comm). An alternative to electrical stimulation is to use a reciprocating blade tenderising machine (Hughes *et al,* 1983).

Details of carcass and meat composition are given in Tables 9 and 10.



A goat carcass (right) hanging beside a sheep carcass of similar weight.

Table 9—Composition of Goat Carcasses at Varying Ages (Robstad, 1976, Skjevdal, 1974)

Age	0 weeks	7 weeks	22 weeks	1 year
Carcass weight (kg)	1.3	5.1	8.4	18.0
Dressing percentage	41	46	44	45
Percent bone-free meat in carcass	53	70	77	82
Content of bone-free carcass				
Dry matter (%)	24	30	35	40
Protein	78	68	59	46
Fatin % of dry matter	8	29	36	53
Ash	1.2		1.1	

From Naude and Hofmeyr (1981)

Table 10—Amino Acid Composition of Meat Samples (g/16gN) (after Srinivasanand Moorjani, 1974)

Amino Acid	Sheep Meat	Goat Meat	Beef
Arginine	6.6	7.4	6.8
Histidine	2.8	2.1	3.0
Lysine	7.9	7.5	8.1
Tryptophan	1.4	1.5	1.4
Phenylalanine	3.3	3.5	3.4
Methionine	3.1	2.7	2.9
Threonine	4.6	4.8	4.5
Leucine	7.6	8.4	7.5
Isoleucine	4.6	5.1	4.5
Valine	5.5	5.4	4.9
Tyrosine	3.0	3.1	3.4
Cystine	1.3	1.2	1.1

Three types of slaughter animals are in demand on the international market (Gall, 1982). These are:

(a) kids, either suckling or weaned;
(b) young goats, mainly culled breeding animals;
(c) older goats, mainly culled breeding animals.

For non-manufacturing purposes the preferred goat carcass is lean, 12-25 kg in weight and produced from a 'halal' slaughter. Sex and age do not appear to be important though some Middle East contracts specify that females should be non-parous (Holst, 1982).

Trade

Australia and New Zealand are the two largest exporters on the world markets. Exports from Australia are sold largely to the Caribbean, Taiwan, Singapore and Malaysia (Holst, 1982). Most goat meat is, however, consumed in the countries where it is produced.

As most countries combine their goat and sheep meat production figures statistical information on the international goat meat trade is unreliable.

New Zealand Situation

There is an established infrastructure for ovine and bovine meat processing and marketing within New Zealand. However, facilities are not always readily available for slaughtering goats and they tend to be processed only at off-peak periods following the seasonal lamb slaughter.

The main companies involved are Borthwicks-CWS Ltd (Waitara), Waitaki NZR Ltd (Wairoa), Aotearoa Meats Ltd (Waikato) and New Zealand Primary Processors Ltd (Rotorua and Taumaranui). However, a number of game packing houses are involved also. Killing charges vary but a guide is offered by quotation of AFFCo charges as of July 1985. Slaughter, dressing, bagging in a polythene bag and then a single stockingette bag, and freezing cost $13.25.

Currently most goat meat is produced in the North Island where year-round slaughter facilities are available (Batten and Alington, 1985). To date production has been from harvested ferals rather than farmed goats and it appears unlikely that goat meat production will be a primary aim on many farms in the foreseeable future. Rather it is likely that it will be a sideline associated with other goat farming enterprises.

Recent New Zealand and Australian production figures, based on Batten and Alington (1985) and I Turk (pers comm) for New Zealand and Australian Bureau of Statistics for Australia, are given in Tables 11 and 12.

North Island processors are paying $7-12 per head at the farm gate, or up to $1.50 per kg carcass weight (Batten and Alington, 1985). On much of the rougher hill country land goats could offer the best return. Hill country farmers already have farms set up which could, at least in part, switch to goat meat production so the industry could readily

Table 11—New Zealand and Australian Goat Meat Exports (June Years)

	81/82	82/83	83/84
New Zealand			
kg (net)	733,320	858,638	684,864
NZ$f.o.b.	1,439,342	1,928,292	1,712,044
f.o.b. (c/kg)	199.74	224.58	250
Australia			
kg (net)	4,513,772	5,427,220	2,998,354
A$f.o.b.	6,154,000	7,896,231	5,645,793
f.o.b.(c/kg)	136.3	145.5	188.3

Table 12—New Zealand Goat Meat Exports (June Ending Years)

	1981/82		1982/83		1983/84	
	kg	$f.o.b.	kg	$f.o.b.	kg	$f.o.b.
Fiji	81,486	156,495	161,007	304,144	112,653	270,940
France	37,277	88,725	33,720	63,680	14,222	30,917
Greece	99,332	27,722	94,465	202,293	90,491	213,899
Guadaloupe	33,574	62,823	87,211	195,179	66,341	182,475
Mauritius	11,506	20,500	31,983	17,211	0	0
Netherlands Antilles	72,414	131,904	38,900	78,658	48,669	96,159
Sweden	43,544	111,958	67,092	204,487	41,470	141,209
Trinidad/ Tobago	169,389	296,279	186,279	557,791	189,630	503,335
Others	184,798	568,355	157,979	304,849	121,388	273,110
Total	733,320	1,464,761	858,638	1,928,292	684,864	1,712,044

expand. Market prospects have been researched recently by Hughes and Sheppard (1983).

Hughes and Sheppard (1983) in their Second Report to the New Zealand Goat Council (Meat Section) drew the following conclusions:

'The countries where New Zealand will have a competitive advantage over Australia, at present, are those countries which prefer lighter carcass weights (Phillips, 1980). The average New Zealand carcass weight (10 kg) is lighter than the average Australian carcass weight (18 kg) (Miller and Sturtz, 1976). Fiji, Spain and the Caribbean countries all prefer relatively small carcasses (8-15 kg).

New Zealand would also have a competitive advantage if it concentrated on just a few countries instead of many. This would mean a more reliable supply to those countries and the establishment of 'loyal' markets, as long as the product suited their requirements. As NewZealand production increases other promising markets could be developed, but irregular supplies at the moment only serve to discredit the product rather than promote it.

For the relatively new markets a 'high quality' product is considered most appropriate to enter with. This will ensure that New Zealand goat meat establishes a good reputation while other product types are 'tested' on the market.

A 'high quality' product is considered to be the type of product acceptable for hotel/restaurant trade in most countries, and the wealthier segments of the population. That is, it would initially be a 'westernised' product in terms of packaging, price, cuts, chilling and tenderness/age.

In conclusion, after considering market size, market growth, costs, risks and competitive advantage, the following markets are left from the original list of 80.

—Greece and Italy—market size, few risks

—Caribbean countries (Dominican Republic, Puerto Rico, Guadalupe, Martinque, Barbadoes, Jamaica, Trinidad and Tobago) and Venezuela—market size, market growth, few costs, small risk, competitive advantage

—SE Asian countries (Hong Kong, Malaysia, Singapore, Taiwan, Indonesia, Japan, Okinawa)—market size, market growth, few costs, small risk.

—Pacific countries (Fiji, Western Samoa, New Caledonia, French Polynesia)—market growth, few costs, small risk, competitive advantage.

New Zealand has exported to most of these countries before with the exception of the South East Asian countries and the other (besides Fiji) Pacific Island countries. The 'established' markets should be supplied with the same type of product

until market tests show otherwise. As mentioned previously the newer markets should be entered with a 'high quality' product.

Once New Zealand goat meat production exports grow past the demand in these markets, other new markets such as some of the Middle East countries (Saudi Arabia, Oman, United Arab Emirates), USSR, China and ethnic markets in East Coast Canada and USA could be tested. These countries show potential for market size and market growth in the future.'

Recommendations made by Hughes and Sheppard (1983):

'1. That existing product types (ie, predominantly carcass) be continued to be exported to established markets (Greece, Italy, the Caribbean and Fiji).

2. The present limited supply should be concentrated to the established markets to ensure these markets are not lost.

3. That the new markets of SE Asia and other Pacific Island countries (see 'Conclusions') be entered initially with a 'high quality' product aimed at the wealthy/restaurant market segment.

4. A market research team (Export Opportunity Team) should be established to investigate new markets/new products in SE Asia and other Pacific Island countries.

5. That appropriate breeding programmes and production systems are developed based on the market research identifying preferred product types in each market.'

A further opportunity for the industry is the development of trade in live goats for slaughter overseas. It is estimated that the Malaysian market alone, for example, could take up to 3000 goats per month (I Turk, pers comm). Saudi Arabia is also a substantial importer of livestock for slaughter (Hughes *et al,* 1983).

Skins

Goat skins form a reasonably valuable product in their final processed form and yield a firmer leather than sheep skins (French, 1970).

Currently, because of the low throughput of goats, farmers do not receive a credit for the by-products but skins are fetching reasonable but variable prices on the international market (Table 13). The main markets over the past few years have been Spain, France, Venezuela and the USA.

Current Research Project

RA822 Goat meat

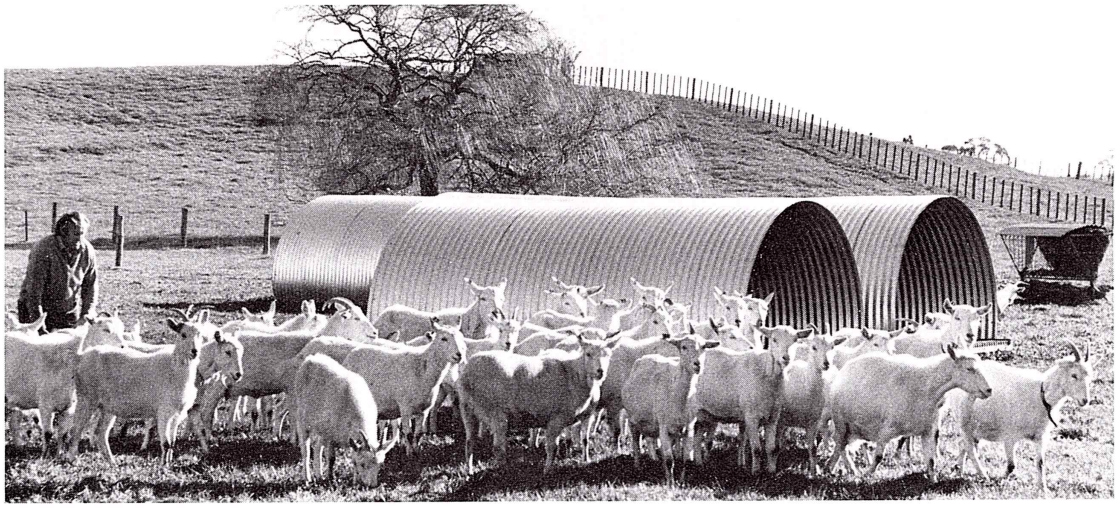
Proposer: A H Kirton, F Colomer-Rocher
Location: Ruakura
Period: Started 1985 finish 1985

Objectives:
This research should provide:

(a) cutting standards for goat carcass research in Europe;

Table 13—Export of NZ Goat Skins for Years Ending June 1983 and June1984

	1983 No.	$f.o.b. each	1984 No.	$f.o.b.each
Korea	8 000	1.47	300	4.69
Philippines	6 914	5.04	3 000	5.60
Spain	7 746	3.40	17 544	3.98
Taiwan	5 000	5.66	0	0
Thailand	2 020	3.19	0	0
USA	10 269	7.25	3 400	10.25
Venezuela	65 119	5.09	17 397	5.34
France	0	0	22 092	0.93
Italy	0	0	3 250	5.56
Others	1 620	3.71	745	6.85
Total	106 688	4.87	67 728	5.4



Ruakura Dairy Goat Herd.

(b) dissection information on the composition of male and female (and wether?) goats of the Saanen and feral/cashmere goats in NZ. Chemical composition data will also be available for comparison with earlier NZ research. Carcass measurements obtained in these experiments are being used by ProAnd Associates to help them in the design for a goat abattoir and they are also very interested in obtaining expected lean meat yields for goat carcasses.

Priorities are to obtain the goats required to cover the chosen range of carcass weights for the different breed/sex classifications.

Table 14—Goat milk production for 1983 (FAO, 1984)

	weight (1000s tonnes)
World	7422
Africa	1471
N & C America	344
S America	136
Asia	3550
Europe	1581
Oceania	very little

MILK PRODUCTION

Product

World production of goat milk and cow milk is currently estimated to be about 7.4 million and 454 million tonnes respectively (FAO, 1984). Goat milk production in New Zealand for the 1984/85 year was 310 tonnes of goat milk powder with an f.o.b. value of $2.2 million. World goat milk production figures are given in Table 14.

The market for goat milk comprises fresh, frozen or dried milk, and processed milk products such as cheeses and yoghurts; the latter are currently traded at relatively high retail prices by the gourmet and health food markets.

Some of the advantages of goats' milk are:

(a) it can be frozen;

(b) it is often, but not always, a valuable substitute for cows' milk when infants and convalescents are allergic to cows' milk;

(c) fats and proteins are in a more finely divided state and more readily digested by infants, geriatric patients and convalescents;

(d) milk is less acidic than cows' milk and has a greater buffering capacity;

Table 15—Average Composition of milk from Certain Mammals

	Water%	Protein%	Fat%	Lactose%	Ash%
Goat	87.33	3.5	4.15	4.2	0.82
Cows (Jersey)	85.60	3.75	5.05	4.84	0.76
Sheep	80.87	5.4	8.05	4.78	0.90
Human	87.60	1.2	3.80	7.00	0.21

Modified from Lampert (1975)

Table 16—Amino Acid Composition of Goat Milk Proteins

	Casein			ββ-Lactoglobulin[3]	
	Goat[1]	Cow[1]	Cow[2]	Goat	Cow B
		....g/100g protein....		...residues/18 300 g...	
Alanine	3.6	3.4	3.2	15	15
Arginine	2.1	4.1	4.1	33	
Aspartic acid	7.4	7.4	7.1	15	15
Cystine + cysteine	0.41	0.42	0.34	55	
Glycine	2.1	2.1	2.0	54	
Glutamic Acid	20.3	23.2	22.4	25	25
Histidine	5.0	3.0	3.1	22	
Isoleucide	4.3	6.6	6.1	9	10
Leucine	9.9	10.0	9.2	20	22
Lysine	8.2	8.1	8.2	15	15
Methionine	3.5	3.2	2.8	44	
Phenylalanine	6.0	5.4	5.0	44	
Proline	14.6	11.8	10.6	88	
Serine	5.2	6.6	6.3	77	
Threonine	5.7	4.3	4.9	88	
Tyrosine	4.8	5.8	6.3	44	
Tryptophane	1.3	1.3	1.7	22	
Valine	5.7	7.5	7.2	109	
Amide N	1.8	1.5	1.6	14	14

Source: Parkash and Jenness (1968).

[1]Holler (1962). [2]Gordon et al (see Webb and Johnson, 1965, p. 60). [3]Phillips and Jenness (1965). From French (1970)

Table 17—Frequency distribution and average size of fat globules in the milk of sheep, goat and the cow (Fahmi, Sirry and Safwat, 1956)

Diameter (mm)	Sheep	Goat	Cow
1.5	28.7	28.4	10.7
3.0	39.7	34.7	32.6
4.5	17.3	19.7	22.1
6.0	12.1	11.7	17.9
7.5	2.0	4.4	12.2
9.5	0.2	1.0	3.1
10.5	-	0.2	1.4
12.0	0.1	-	0.1
13.5	-	-	
15.0	-	-	
16.5	-	-	
18.0	-	-	
Average diameter (μm):	3.30	3.49	4.55

From Devendra (1975)

Table 18—Mean Mineral Composition of Goat's Milk

Component	mg/100ml
Sodium	38.8
Potassium	192.3
Calcium	136.2
Magnesium	26.4
Phosphorus total	102.2
Phosphorus inorganic	81.0
Chloride	176.3
Citrate (as citric acid)	150.9

Modified from French (1970)

Table 19—Vitamin Contents of Milk

Vitamin	Cow's milk		Goat's milk	Human milk
	Mean	Range		
Vitamin A[1]	1 560	1 190-1 760	2 074	1898
Vitamin D	-	-	23.7	22
Thiamine	0.44	0.20-0.80	0.40	0.16
Riboflavin	1.75	0.81-2.58	1.84	0.36
Nicotinic acid	0.94	0.30-2.00	1.87	1.47
Vitamin B6	0.64	0.22-1.90	0.07	0.10
Pantothenic acid	3.46	2.60-4.90	3.44	1.84
Biotin	0.031	0.012-0.060	0.039	0.008
Folic acid	0.0028	0.0004-0.0062	0.0024	0.0020
Vitamin B12	0.0043	0.0024-0.0074	0.0006	0.0003
Ascorbic acid	21.1	16.5-27.5	15	43
Choline	121	43-218	150	90
Insitol	110	60.180	210	330

Source: Parkash and Jenness (1968)
[1]Vitamin A as IU/litre: other values in mg/litre.
From French (1970)

Table 20—Percentage Fat and Solids-not-fat Contents in Milk from Different Breeds of Goat

Solids-not-fat			Fat		
Nubian	Toggenburg	Saanen	Nubian	Toggenburg	Saanen
5.60	3.81	4.02	9.17	8.40	8.47
4.41	3.54	4.18	9.25	8.77	9.42
6.63	4.97	4.95	10.50	9.21	9.29
4.45	3.73	3.66	8.92	8.47	8.48
5.0	3.8	4.7	-	-	-
-	-	3.5	-	-	8.2

Modified from French (1970)

(e) the higher phosphate content may be useful for vegetarians.

Tables 15-20 give values for the various constituents of goat milk.

Good does produce 2.2-3.3 litres of milk a day, or 8-15 times their own weight over an 8-10 months' lactation (Packard, 1980). Packard (1980) claims that an average annual yield of at least 720 kg of milk should be well within the reach of a good commercial herd.

New Zealand Situation

This section is a summary of a sector analysis paper prepared by Claire Douglas (Economics Division, MAF).

Dairy Goat Advisory Committee

This Committee is established in terms of section 13 of the Dairy Board Act and provides an authority for taking decisions on licensing of exporters, price pooling, production controls, etc. The main exporters and a representative from each cooperative are members of this committee. One Government representative, without voting power, is included.

Dairy Goat Industry Society

This organisation represents the commercial interests of its member co-operatives and collects a levy on production to finance its research and administrative functions. The Society facilitates the industry pooling arrangements, organises export orders and distributes payments to producers.

Dairy Board

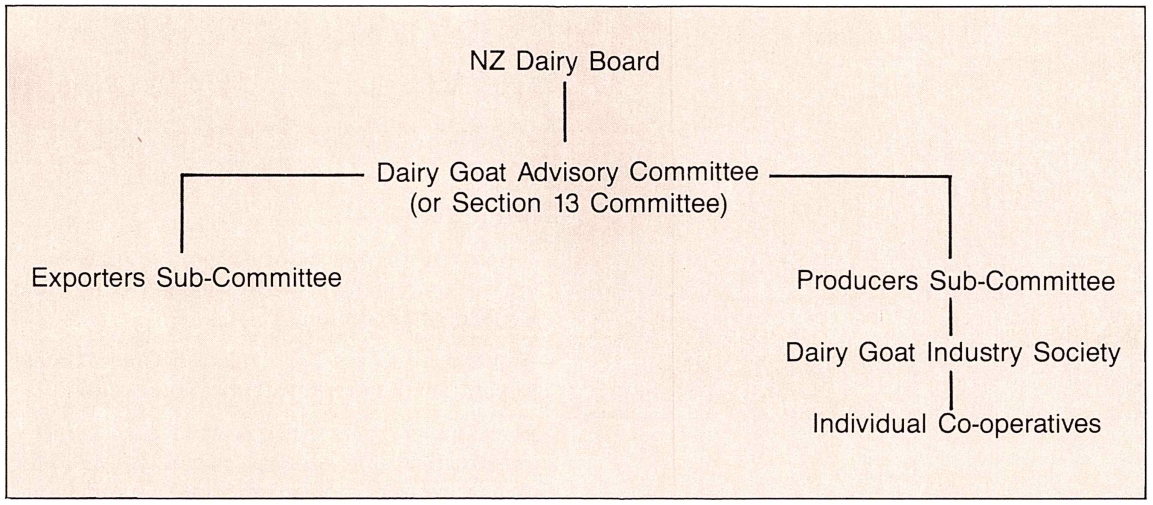
The Board's role is supervisory through the Section 13 Committee and it is not directly involved in the marketing of dairy goat produce. The Board is directly involved with the Rural Bank in the administration of seasonal stock finance to the Dairy Goat Industry Society.

The number of dairy goats is estimated to be between 16,000—20,000 goats, the majority of which are being milked in commercial goat milk cooperatives. In the 1984/85 season there were 157 suppliers involved in these cooperatives, milking about 14,300 does.

The commercial milking herd has developed from a mix of pedigree with Saanen dominating, and cross-bred animals. Milk yields vary considerably but are now improving to reach commercial international levels of 700 litres per doe per annum.

High prices for goat milk powder in the mid 1970s encouraged rapid development of dairy goat farming and production of goat milk powder rose from eight tonnes of powder in 1976/77 to 310 tonnes in 1984/85.

Marketing difficulties in 1982/83 led to Government intervention in the form of a seasonal loan from the Rural Banking and Finance Corporation. This loan has since been repaid and farmers' cash position is much sounder. The Rural Bank is providing further seasonal finance which is stabilising production by enabling producers to receive advance payments for their milk.



In the 1984/85 season there were six commercial dairy goat cooperatives in New Zealand, with milk processing arrangements secured at various dairy cooperative companies. There are a number of producers operating outside the cooperative structure who supply fresh milk to urban centres, and some who are making cheese.

Relative to the dairy cow industry, processing costs are high due to the scattered production base and small scale processing runs. These high processing costs serve to reduce producer returns and their farm profitability.

Limited product development has been achieved to date largely because of lack of finance, a poorly developed organisational structure and inconsistent availability of milk. Some product development is being undertaken now with the assistance of dairy companies. A limited amount of finance is available from the levy collected on milk powder sales. Availability of milk for product development purposes has improved with greater milk production levels.

The main exporter is Healtheries Ltd and the most important market is Taiwan, followed by Australia, United Kingdom, China and the Middle East. Recent export totals are given in Table 21.

Sale volumes have been erratic because of uncoordinated marketing in the past. Since the formation of the Dairy Goat Advisory Committee and with the advice of the Dairy Board, marketing performance has improved. Under this Committee, exporters are licensed and at present there are four licensed exporters. Regular meetings of this committee and its producer and exporter members provides a market feed-back mechanism to the industry.

Opportunities

The New Zealand dairy goat industry is capable of increasing its biological base by about 40 percent per annum. From a base stock level of 14 300 does the national herd could reach to over 100 000 does by 1990. Milk powder production could reach about 7 500 tonnes, worth $50 million annually in 1985 dollars. However, based on expected export demand for New Zealand products, production is more likely to be restrained to a level of 1 500–2 000 tonnes, worth about $10-12 million annually.

The opportunities for developing markets for other goat milk products have yet to be fully researched but the prospects for expanding the goat cheese production for export are favourable. UHT milk is now being produced also.

New Zealand milk powder production in recent years is estimated in Table 21:

Table 21—Goat Milk Powder Production

Year	Tonnes
1976/77	8
1977/78	12
1978/79	28
1979/80	50
1980/81	100
1981/82	220
1982/83	311
1983/84	110
1984/85	310

Current Research Projects

RA567/05 Genetic selection programme for Ruakura dairy goats

Proposer: G L Bennett;
Period: Started 1982, finish 1990

Objectives:

Primarily to improve herd milk yield through genetic improvement.

Secondarily, to study reproductive, nutrition and management factors associated with running a herd of Saanen dairy goats.

Approach:

A 100 doe dairy goat herd has been established at Ruakura. Founding goats were a cross-section of those bred by industry.

Initially all females were reared, except those with obvious defects, and retained until the completion of their second lactation. Half of these were then culled on the basis of their lactation records. The top half was then retained for two additional matings. Female kids born to the half (based on first lactation records) of second lactation does and to all third and fourth lactation does are now reared for replacements. All males born to first lactation does are reared and retained until selection. This is made on the basis of their dams' second lactation records. Five males are then chosen for mating at 18 months of age. Female kids born to first lactation does and male kids born to second lactation and older does are discarded at birth.

Others are listed following 'Diseases'.

REQUIREMENTS FOR DEVELOPMENT OF THE NZ GOAT INDUSTRY

Marketing

—improved market information on processor's fibre requirements with regard to fibre specification and volumes

—improved forecasting relating international competition and prices with local production

—development of a New Zealand goat industry infra-structure for strategic planning and for linking information, finance, production, transport, marketing and processing

—identify market opportunities for cashgora in the international fibre market

—identify and negotiate opportunities to export live goats.

Product Supply

—identify highly productive goats which produce fibre, meat or milk to industry specifications

—increase national flock numbers using high genetic merit stock

—improve goat farming productivity by minimising stock losses, integrating goats with other livestock and using goats for weed control.

RESEARCH RESPONSES FOR DEVELOPING THE NEW ZEALAND GOAT INDUSTRY

Considerable emphasis must be given to improving productivity which along with market development is the long term key to establishing a profitable goat industry in New Zealand.

Increases in goat milk productivity have already been achieved up to international levels whereas fibre producers must achieve substantial increases in fleece weight in yields of high value fibre. The rate of progress will require research on:

—screening the national goat gene pool
—identifying high genetic merit goats
—developing selection methods based on heritabilities of production traits
—using genetic data to develop a 'goatplan'
—identifying breeding routes most appropriate for producers breeding objectives.
—use of modern breeding technologies such as immunisation to increase kidding rates, and artificial insemination and embryo transfer to expand elite gene pools rapidly. The latter technique is being used by industry but is relatively expensive and is mainly used for high quality stock. Considerable improvement in semen preservation and artificial insemination should be achievable thereby providing a widely available technology for goat herd improvement.

As genetic quality increases improved management will be needed for goats to achieve their genetic potential. Research must provide data to:

—reduce losses especially kid mortality
—establish seasonal nutritional requirements for production target weights (ie, liveweights at mating) to be reached
— develop grazing management systems to maximise feed supply and utilisation.
—recommend parasite control strategies for maximising the benefit:cost ratio and to minimise the likelihood of causing anthelmintic resistance
—maximising the yield of product
—identify disease control procedures especially disease of the feet
—identify and overcome behavioural problems

ACCESSING ARD RESEARCH INFORMATION ON GOATS

Research results from within Agricultural Research Division are kept on computer and generally are available to the public. However, commercially sensitive reports remain confidential and can only be accessed from the computer by authorised personnel.

The system employed, known as CAMIS (Computerised Agricultural Management Information System), provides facilities for selecting and displaying information about research projects.

CAMIS covers a number of application areas including:

Research Projects System
— descriptive information on research projects
— covers projects of Agricultural Research and Fisheries Research Divisions
— general access available

Publications System
— publications by Agricultural Research Division staff.

CAMIS operates on the Ruakura node of the MAF network.

The Research Projects System contains the following details for each project:
— accession number and project ID
— title
— status (open, closed or confidential)
— project proposer and cooperators
— dates—start, end and review
— keywords
— research area and programme
— station
— MAF locations
— countries
— NRAC category.

As well as the classification factors listed above the system stores textual summaries of two types:
— approach and objectives
— latest interim or final report

The CAMIS Project Inquiry System is the principal means of retrieving information from the Research Projects System. Inquiries are entered interactively and results may be returned to the users terminal and/or directed to a line-printer.

CAMIS inquiries can be made by contacting
Scientific Liaison Officer,
Agricultural Research Division,
Ministry of Agriculture and Fisheries,
Private Bag,
Wellington, ph 739-410
OR at any of the following MAF offices.

North Island

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Wellington
Winchmore
Dunedin
Mosgiel

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APPENDIX I

POISONOUS PLANTS

Acorns (2)
Arum
Azaleas
Anemone
Black nightshade
Broom
Buttercup
Cupresses
Daffodil
Daphne (2)
Deadly nightshade
Delphinium (1)
Foxglove
Gladiolus
Goat's rue *Galega officinalis* (3)
Gourds
Hemlock
Iris
Juniper
Laburnum
Laurel (2)
Lily-of-the-Valley (1)
Lobelia (1)
Lupins (yellow)
Nightshades (all)
Ngaio (2)
Old mans beard
Oleander (1)
Privet
Potato tops
Pines
Ragwort
Rhododendron
Rhubarb
Stinging nettle (2)
St John's wort (2)
Thorn apple
Tomato greenstuff
Yew

References: no figure, Hetherington (1977)
(1) Gregory (1976)
(2) Rumble (1985)
(3) Anon (1985b)

APPENDIX II

CURRENT RESEARCH PROJECTS ON FERAL GOATS

(Rudge *et al*, 1985)

FOREST RESEARCH INSTITUTE

— Protection Forestry Division, Ilam

*	Productivity of goats on Raoul Id	J P Parkes
*	Control of feral goats on Raoul Id	J P Parkes
*	Diet of feral goats on Raoul Id	J P Parkes
*	Geographic variation in breeding season and productivity in NZ (planning stage)	J P Parkes
*	Methods of controlling feral goats (continuing)	J P Parkes
*	Reproduction in Arapawa goats (reporting stage)	C N Challies
*	1080 Poisoning in the Raukumaras (continuing)	J P Parkes
*	Density, distribution and effects on vegetation of various feral goat herds (continuing monitoring)	NZFS

DSIR

— Grasslands Division, Palmerston North

*	Goats for coarse weed control in hill country	D A Clark

— Ecology Division

*	Age determination in goats (assessment of several methods—advanced report stage)	M R Rudge
*	Habitat use, movements and activity of goats in the Orongorongo Valley (awaits analysis)	M R Rudge
*	Diet and food selection in the Orongorongo Valley (continuing analysis)	D J Campbell
*	Goats on the Auckland Islands (continued study of marked vegetation plots, published up to date)	D J Campbell and M R Rudge
*	Review of world status (reports for IUCN completed, and FAO continuing)	

LANDS AND SURVEY

— Lincoln

*	Goats to control sweet briar (May 1981-May 1984)	G L Holgate

— Nelson Office (Ngawatu)

*	Evaluation of Arapawa goats (milk and meat production selective breeding for cashmere—continuing)	P H P Houghton (jointly with MAF)

LINCOLN COLLEGE

— Animal Sciences Group

*	Comparative utilisation of forage by sheep and feral goats (part of a PhD project—continuing)	M R Alam and F Borens
*	Selection for growth rate and cashmere production (continuing)	A S Familton and B M Tinnock
*	Comparative grazing intake and diet of young feral goats, lambs and calves (PhD project)	T P Hughes

— Agricultural Economics Research Unit

*	Market prospects for goat meat (includes feral derived animals)	R L Sheppard
*	Evaluating the use of goats for weed control (reporting stage, a synopsis of results and prospects)	M Krause

— Dept of Wool Science

*	Comparison of different methods for preparing and measuring mohair and cashmere fibres (continuing)	B M Tinnock and B R Wilkinson

MASSEY UNIVERSITY

— Botany and Zoology Department

*	Diet and food preferences of feral goats on Mt Egmont (NZFS research contract)	MSc by J Mitchell under Prof B Springett

Besides work on feral/fibre goats at Ballantrae, DSIR involvement in goat research is largely through WRONZ which is 30% funded by Government through the DSIR Vote. It appears likely that problems such as the dehairing of Cashmere could be investigated by WRONZ in the event of appropriate financial support becoming available from industry sources.

The Department of Lands and Survey has farmed Angora goats for many years, mainly on the Waitangi farm. Goat research in the Department is carried out in collaboration with Agricultural Research Division staff at Whatawhata and Ruakura. Research is chiefly in the fields of genetics and the technology associated with enhancing the reproductive potential of the base Angora flock by embryo transfer and splitting. Studies on heritabilities are continuing.

Stock firms are currently showing considerable interest in the goat industry and are supportive of farmers wishing to diversify or establish new goat enterprises.

The high value of pure-bred Angora stock has led several commercial enterprises into the field of embryo transfer. Concomitant with the high value of stock many companies are developing and marketing the farming equipment needed for successful goat farming—from fences and scales to shearing equipment.

Contacts are included in 'Contacts in Agriculture 1985' published by MAF Information Services, Wellington.

APPENDIX III

Aglinks Goats, Management for Meat Production Batten G J	FPP281
Goats, Management, Scrub Weed Control Batten G J	FPP280
Goats, Meat Production, Industry and Economics Batten G J, Alington E	FPP355
Goats, Common Diseases Brookbanks E O, Lord B E T, Parkard P M, Ellison R S	FPP22
Goats, Diseases, Description of important diseases Ellison R	AST116
Goats, Breeding, Artificial Insemination Goold P G, Tervit H R	FPP641
Goats, Milk Production, Rearing Kids Horton C T	FPP805
Goats, Milk Production, Feeding Horton C T, Jagusch K T	FPP803
Goats, Products and Statistics Kirton A H, Batten G J, Horton C T	FPP353
Goats, Caprine Arthritis-encephalitis MacKenzie R, Oliver R E	FPP98
Goats, Milk Production Packard P M	FPP 7/2
Footrot in sheep, zinc sulphate footbathing, efficacy advantages use Skerman T M, Green R S, Moorehouse S R	FPP790
Goats, Breeding, Embryo Transfer Tervit R H, Goold P G	FPP586
Livestock, Breeding and Marking Gibbons G, Evans P, Cameron J, Nickel M	FPP705

New Zealand Ministry of Agriculture and Fisheries, Wellington 1985

MAF Agricultural Research